

# **Mid-Canada Development Corridor**

***...a concept***





## Foreword

Demand for copies of the Acres' publication "Canada North Development Corridor . . . a Concept", published last June, has been so great that a second edition now follows. It is encouraging indeed to find so much Canadian interest in the northern resources and undeveloped space we have within our borders.

The foreword to the first edition read:

*"The anomaly presented by Canada's vast areas of potentially rich northern resources and undeveloped space in relation to the highly developed 200-mile southern band, concerns all interested in our optimum economic development. There is a constant search for the vehicle to support intensive investigations and development of northern resources.*

*"Richard Rohmer has, in retaining the professional services of Acres for this study of Canada North Development Corridor, provided us with an opportunity of applying our resource and planning skills to a challenging task. Northern development is among the most inspiring Canadian opportunities which lie ahead. There is little doubt that the next decade will bring great progress in this field.*

*"This document presents the results of a preliminary study and should form the basis for an intensive research and planning program to achieve fullest possible benefit from our northern resources."*

In this second edition, we have identified the development corridor as a Mid-Canada concept. Vast areas of the true north, awaiting further enterprising development, lie beyond.



C. N. Simpson  
President, Acres Limited

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## Highlights of the Study



- Canada is expected to become a giant among the productive nations of the world.
- Canada's future is inseparably linked with the development of Mid-Canada.
- Mid-Canada is largely a habitable region with a cool but acceptable climate, and a rugged but accessible terrain.
- Mid-Canada is primarily undeveloped territory.
- Mid-Canada possesses an immense wealth of developed and undeveloped resources of minerals, fuels, forests, water, and tourism.
- Exploration and resource developments are independently moving north from the developed regions in the south of Canada.
- Transportation and accessibility are the key elements in the further development of Mid-Canada.
- Preliminary study of Mid-Canada indicates that, initially, transportation may best be provided by an east-west oriented system of railways and highways, augmented in the future by new modes of transportation.
- Preliminary study supports the concept of a coast-to-coast Mid-Canada Development Corridor.
- The Mid-Canada Development Corridor is identified as an area with the following general characteristics:
  - the climate is acceptable for working and living;
  - the terrain is accessible and suitable for development;
  - resources are abundant and well-distributed;
  - settlements already exist;
  - there are potential urban growth centres;
  - north-south transportation routes already reach into the area;
  - new east-west transportation routes can be provided in a reasonable manner.
- People, capital, resources, foresight, and initiative are required for the development of Mid-Canada.
- The development of Mid-Canada should be a Canadian undertaking, financed by public and private funds.
- The development of Mid-Canada should be part of a national planning policy.



## Introduction

For the purpose of this study, Mid-Canada is that part of mainland Canada which is north of the contiguous belt of urban and rural settlement, and south of a generalized line which forms the northern limit of the tree zone (see map on previous page). Much of this area is considered to be a frigid, barren wasteland, beset with fantastic problems of climate and lengthy periods of darkness, which permit only semi-permanent life. This description is most inaccurate. Mid-Canada is cold, but not constantly or intensely so in all regions. The effective boundary of the southern climate extends far down the Mackenzie River valley. The summers are short but pleasantly warm. There are two or three months of frost-free days and, during the long days of summer, plant growth is practically uninterrupted. Already well-settled communities exist in Mid-Canada, and there are substantial acreages of arable land. Although the degree of isolation of existing settlements is still high, living conditions closely resemble those of towns in southern Canada. With improved communications, transportation and economic opportunities, more people will settle in Mid-Canada and will find life quite acceptable.

The Royal Commission on Canada's Economic Prospects (1957) described the prospect of immediate economic ex-

pansion of northern areas as "unfavorable". They could not see a close analogy between the historical opening of the west for political and defence purposes, and a similar pressure for the economic development of the north. However, 10 years later, the Throne Speech at the opening of the 1967 Parliament, contained the following reference: "At the same time, the search for new resources hastens the opening of the north. Substantial progress has been made in recent years in the government of the Northwest Territories and the Yukon, and the government intends to undertake new incentives for industry and regional economic planning intended to strengthen the economy of the north".

Canada's future is inseparably linked with the development of natural resources, transportation and defence in Mid-Canada. This is a vast, undeveloped, but most important area, with the potential to support millions of people. Unlimited potential for the extension of economic activity and settlement into Mid-Canada will be realized with the advent of more efficient forms of transportation, better communications, new port development on the Arctic, Pacific and Atlantic Oceans, new forms of environmentally-controlled town development, and the provision of more amenities and incentives for residents. Many

experts share this view, with increasing support from the public, who have made statements such as: "In the next 100 years, as population expands and the immense natural wealth is developed, Canada is expected to become a giant among the productive nations of the world" (*U.S. News and World Report*, April 10, 1967).

This study stems from the conviction that development and settlement in Mid-Canada is economically and socially justified. Mid-Canada is a treasure house of natural resources. This area produces most of the world's nickel, and is a leading producer of zinc, iron, asbestos, potash, uranium, newsprint, hydro-electric power, oil and gas. It has tremendous reserves and potential in most of the basic resources which are vital to the world's population in this nuclear age. The only additional requirements are the human and capital resources which are necessary to develop the country's wealth.

Canada's population is now 20 million. At the present rate of growth we can expect to have 30 million people by 1985, and 120 million by the year 2067. An accelerated rate of immigration from the present 250,000 persons per annum would advance these dates considerably.

The future population, whatever the



size, will be linked closely to the economic opportunities available in Canada. The size will also depend, to a large degree, on whether or not the economy is guided by national policies and directives, or whether it is allowed to grow without a specific development plan. Development of the tremendous wealth of Mid-Canada over the next decades will require vast amounts of capital — perhaps \$4 to \$5 billion. If phased over a period of 20 to 25 years, this would amount to annual expenditures of some \$200 million. Compared with certain large expenditures now channelled into relatively small regions of the country, these amounts cannot be considered exorbitant. Indications are that the costs of the Mid-Canada Development Corridor will be far outweighed by the returns to be gained from optimum utilization of our country's resources.

Much can be learned from northern development in other nations, such as Russia and the Scandinavian countries. Although the Russian north differs in many respects from the Canadian north, determined efforts to settle and exploit the Siberian snow desert are encouraging. Vast tracts of Mid-Canada could be developed in a similar fashion. This development should be part of a national planning policy, based upon existing activities, known potential, modern tech-

nology, and a planned comprehensive approach.

Potential exists in almost every region in northern British Columbia, the Mackenzie Valley, the Canadian Shield, Labrador, northern Quebec, and the Ungava District. The raw materials, energy sources, and water supplies for industrial and domestic use, are waiting to be exploited. According to R. G. Robertson, former Deputy Minister of Northern Affairs and Natural Resources, it is not unreasonable to expect that, in the Northwest Territories, the area of Precambrian rock, which is three times larger than the similar area in Ontario, will also have three times the metallic mineral occurrence. The amount of oil and gas in the Northwest Territories may be three times the present oil wealth of Alberta. Labrador and northern Quebec hold extensive resources of minerals such as iron and nickel, along with tremendous undeveloped power resources.

Co-ordination, direction and planning for a timed, integrated development of existing and potential activities is urgently required. In the immediate past, detailed studies and surveys were made of special aspects of the environment, development and habitation of Mid-Canada. But little or no effort was made to take a total approach to northern development, or to take a comprehensive look

at the major factors which determine the extent and the rate of development in Mid-Canada. This study is an initial attempt to examine the development of Mid-Canada. A systematic survey is required and a total framework should be established within which all parts and development criteria can be related.

This study has several limitations, arising from a lack of up-to-date information and adequate financial resources. The major limitation is inherent in the conceptual nature of this proposal for the establishment of a Mid-Canada Development Corridor which, if it were to be established, would be a Canadian undertaking of the greatest magnitude. The value of this study is not in the detail of the text or the maps, but in the comprehensive approach and comparative analysis of the criteria which are used to examine the validity of the concept of Mid-Canada development.

The study examines the viability of the development of Mid-Canada and proceeds to outline a possible development corridor concept. It is a planned approach, calculated to achieve the optimum use of resources, the accommodation of an increased population, and the creation of a higher standard of living for all Canadians — in short, to develop a greater Canada.



## 1—Historic Development

Canada, the second largest country in the world in area, occupies more than half of the North American continent. Its total land area of more than 3.8 million square miles includes 271,000 square miles of developed agricultural land, 930,000 square miles of productive forest land, 2,358,000 square miles of non-productive forest and wastelands, and 292,000 square miles of fresh water.

Canada has an immense variety of physical features, climates, geologic formations, fauna, and flora. Predominant among the geographic features are an irregular and deeply indented mainland coastline, 18,000 miles long; and the Canadian Shield, with a wealth of minerals contained in its 2 million square miles. The Shield and the Interior Plains comprise most of Mid-Canada.

Canada's population now stands at approximately 20 million. The rate of growth since 1900 has varied considerably, and reached an average rate of 3 percent between 1951 and 1961. Most of the population lives in a narrow band along the southern border of the country, while Mid-Canada is sparsely populated. Location of settlement was influenced strongly by climate, soils, and elevation of the land. Man is now increasingly capable of influencing his own environment, and of bringing about changes which allow development in areas previously considered to be inaccessible and uninhabitable.

The most significant sources of national wealth are agriculture, mining, forestry, and fisheries. The combined value of production runs into billions of

dollars. Canada's Gross National Product in 1966 was \$57,781,000,000. Food products, iron, steel, transportation equipment, paper and wood products, are the leading manufactured goods. Due to Canada's vast natural wealth, its per capita export trade is the largest in the world.

Transportation and communication facilities contributed enormously to Canada's early development. As the country was opened up, major sections of road and rail were constructed initially for political and military reasons, but the economic and social benefits quickly became apparent. In spite of the physical north-south configuration of the continent, Canadian settlement and communications developed east-to-west, in a belt a few hundred miles wide and approximately 4,000 miles long.

Apart from major water transportation routes, it was the railways, with their long distance and bulk hauling facilities, which were largely responsible for economic development in the southern belt and for small pockets of development in Mid-Canada. Later, highways played a similar role while, even more recently, airlines have been particularly useful for exploration and for the establishment of outposts in otherwise inaccessible areas.

Early resource explorations into Mid-Canada were made by French and English fur traders in pursuit of the natural resource wealth of the area. Many of these men, including Alexander MacKenzie and Simon Fraser, made valuable maps and records which were the basis

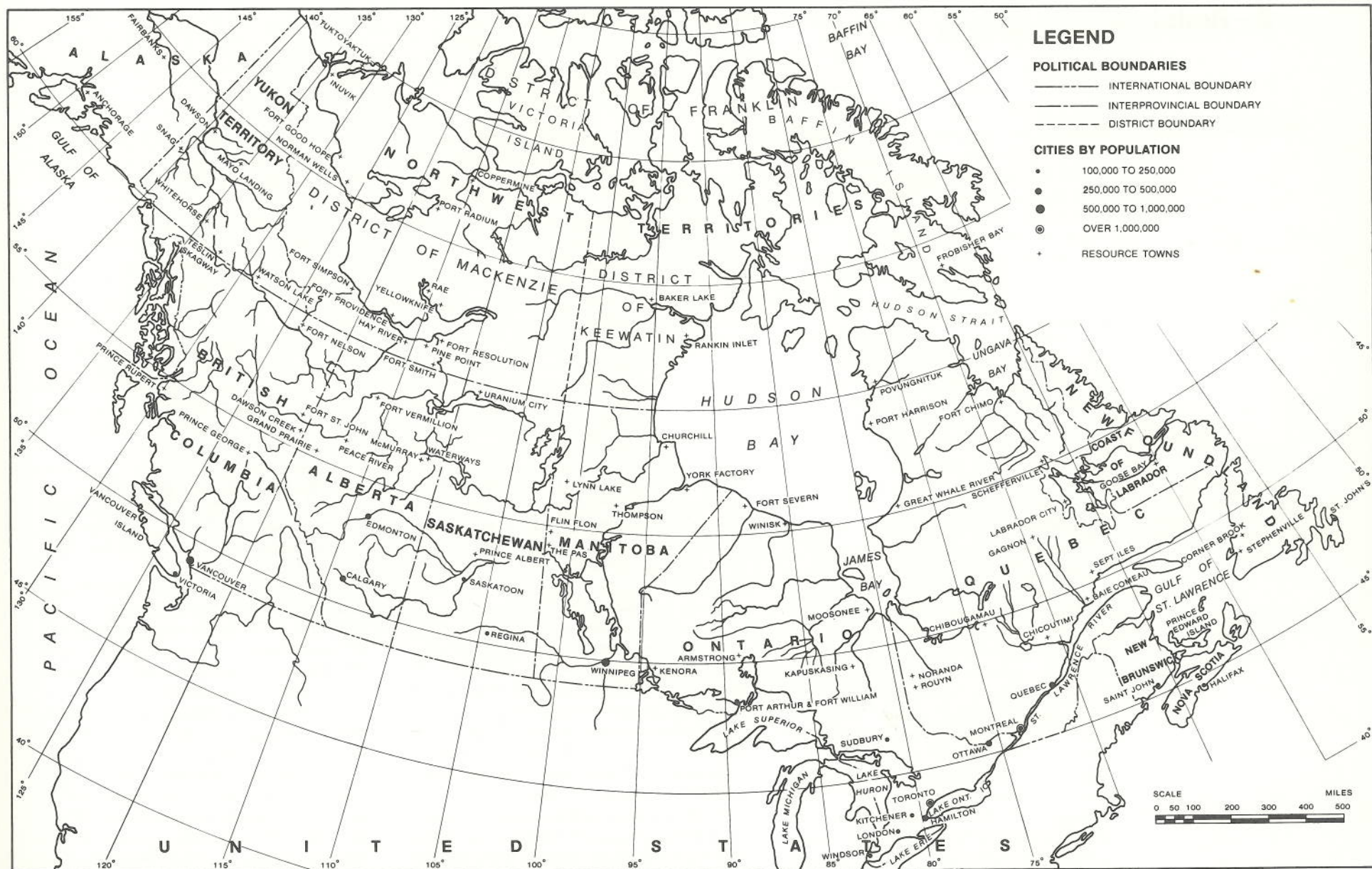
for further exploration. Other than the lumber trade in the St. Lawrence valley, there was little economic activity in Mid-Canada from the fur trading period until the discovery of gold in the Yukon, followed by the discovery of the rich silver deposits at Cobalt in northern Ontario. This stimulated further exploration, and eventually led to the emergence of Canada as one of the most important mineral-producing countries in the world.

The rapid expansion of the pulp and paper industry in Canada has been based on important resources also found in Mid-Canada — forests and hydro-electric power.

During and after World War II, defence considerations forced both Canada and the U.S. to develop transportation and communications facilities in Mid-Canada. Weather stations, airstrips, radar stations, roads and pipelines were constructed. Defence money was poured into the region. However, in the sixties, a changing emphasis in defence occurred and many military bases were closed, causing much local hardship.

In more recent years, exploration activities, new mineral discoveries, and political interest in Mid-Canada, have brought about some further development, although this has been sporadic and unco-ordinated. Fortunately most of the development is based on the long-term outlook of the demand for the resources, rather than the short-term returns. With the potential of Mid-Canada assuming greater significance, the need to plan for its growth and development is imperative.







## 2—Relief

Plate 2 is a generalized contour map of Canada. Since relief and physiography are closely related, Plate 2 should be studied in conjunction with Plate 3, which shows the physiographic regions of Canada.

Only a small portion of Canada rises higher than 4,000 feet above sea level. This occurs primarily in the west, in the Cordilleran region. Here, more than 70 peaks rise above 11,000 feet. The highest Canadian mountain range is the St. Elias range, located in the southwestern corner of the Yukon. Mount Logan, Canada's highest peak (19,850 feet), is in that range.

Other Canadian mountain ranges are the Shickshocks in the Gaspé Peninsula and the Torngats in eastern Labrador. Perhaps the least known mountainous region in Canada is in the Arctic where a range, with peaks up to 8,000 feet high, runs along the northeastern coast of Baffin Island and continues on up to the

northern tip of Ellesmere Island.

The Prairie Provinces are usually considered to be flat whereas, in actual fact, they rise approximately 2,500 feet from east to west.

Hudson Bay is in the centre of a huge basin surrounded by an upland rim. Its shoreline is flat, particularly on the south and east coasts. As one moves away from the shore, however, the land becomes higher and more rugged.

The important aspect of the topography of any given area is the difference between the highest and lowest parts. This difference is referred to as the "local relief" of the area. If the local relief is great, then steep slopes, deep valleys and fast rivers are likely to occur. In this type of area, the establishment of a ground transportation system will be difficult and costly. If an area has little local relief and adequate drainage, transportation can be established more easily.





### 3—Physiographic Regions

Physiographic regions are designated by similarity of landscape characteristics. Geology, local relief and drainage patterns are all important factors. On this basis Canada can be divided into eight physiographic regions. Except for the Innuition Region in the High Arctic, they appear on Plate 3, and are listed as follows:

**(1) Arctic Lowlands and Plateaus**

This region is underlain by sedimentary rock. The terrain is gently rolling, with occasional rock outcrops. Economic activity centres around minerals, although oil is known to exist. Permafrost forms the major obstacle to physical development.

**(2) Canadian Shield**

This is the oldest (over 600 million years old) and largest (47 percent of the total area of Canada) of the physiographic regions. A formerly mountainous area, it was worn down by glacial activity and weathering to its present state — a hummocky area with a thin, patchy soil cover. The region is poorly drained, and contains thousands of lakes and numerous muskeg areas. The Shield is rich in minerals and is the source of a large percent-

age of our present mineral production. Forestry and the production of power are also important economic activities. There are pockets of agriculture in old lake bottoms where clay has been deposited. Granitic outcrops and muskeg present problems in physical development.

**(3) Hudson Bay Lowlands**

Underlain by sedimentary rocks, the region has a very gentle slope from south to north. As a result, drainage is extremely poor and muskeg is widespread — a major deterrent to physical development. Other than hunting or trapping, there are few economic activities in the region.

**(4) Cordilleran Region**

This is a region of rugged mountains, steep slopes, deep valleys, and interior plateaus. The mountains are young and have not yet been rounded-off by extensive weathering. Mining, forestry, hydroelectric power, fisheries and agriculture are all important resource industries in this region. The rugged nature of the terrain makes transportation and communications difficult and costly, but not impossible.

**(5) Interior Plains**

The Interior Plains region is a large, continental depression of sedimentary rocks. Because of its relatively flat relief and fertile soils, the area is ideal for agriculture. Oil, gas and minerals are important resources. There are no major obstacles to transportation and physical development in this region.

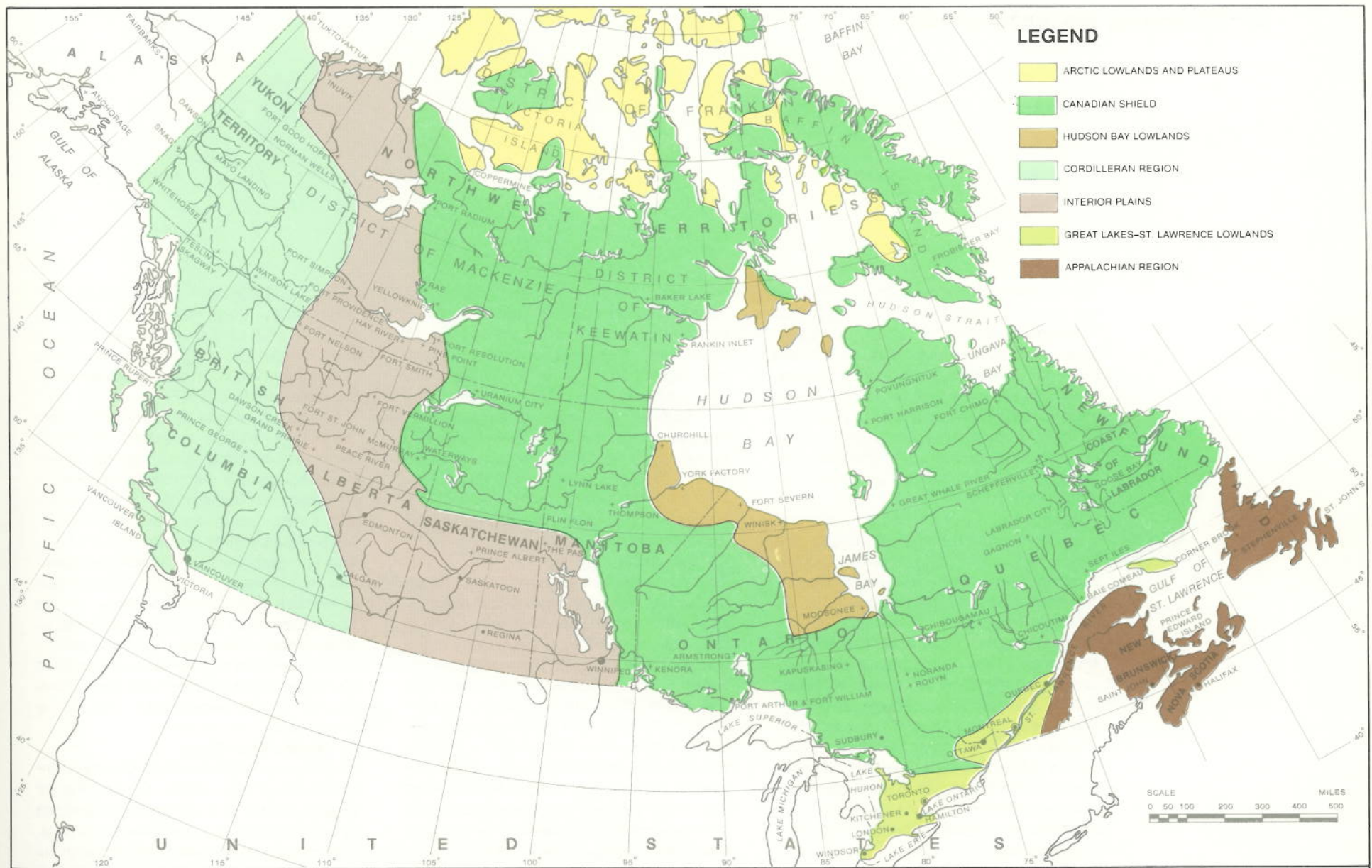
**(6) Great Lakes-St. Lawrence Lowlands**

This region, of gently rolling topography underlain by sedimentary rocks, is cut in half by an extension of the Canadian Shield. This extension, known as the "Frontenac Axis", crosses the St. Lawrence River near Kingston. With fertile soils, accessibility, favorable climate and an abundance of power sites, this region has become the most densely populated in Canada.

**(7) Appalachian Region**

In this mountainous region, the igneous sedimentary and metamorphic rocks were rounded-off by prolonged periods of erosion. Timber and minerals are the most important resources in this region, with agriculture occurring only in pockets in the valleys, and along the coasts. Transportation routes are found mainly in the valleys and along the coasts.







## 4—Climatic Regions

The climate of any given area is the result of a combination of many elements. Temperature, precipitation, humidity, wind, air pressure and length of day are the most important components. Several geographical phenomena have a major effect on climate — such as the proximity of large bodies of water, relief, ocean currents, and global air circulation patterns. These are called “climatic controls”.

Because of the many factors affecting climate, numerous methods exist for the classification of climatic regions. The criteria on which these are based depend on which elements are considered to be the most important.

The climatic regions of Canada, as shown on Plate 4, are based on Koepen's classification of world climates. This is a widely accepted classification, and is used by the Atlas of Canada, 1958.

Koepfen, a German biologist, based his classification on the relationship between natural vegetation and temperature, rainfall and seasonality. Under this classification, Canada is divided into five major groups:

### (1) Tundra

Tundra climates occur in response to either high latitude and/or high altitude.

Temperatures are varied, but generally

the mean temperature of the warmest month is between 32°F. and 50°F. Maximum temperatures can reach as high as 80°F., but on the average summer day, they reach 50°F. to 55°F. Winters are long and cold (sub-zero).

Precipitation is variable, not only during the year but also from year-to-year. Generally it is quite low in the arctic tundra (5 to 10 inches), but very heavy in the alpine tundra (up to 100 inches). Maximum precipitation occurs during the summer.

### (2) Sub-Arctic

This is the most extensive climatic region in Canada. The region has a cool summer of no more than 3 months, with a mean temperature of 50°F. or more. July is the warmest month, with temperatures between 55°F. and 65°F. Absolute maxima may reach 90°F., but the usual daily high is from 70°F. to 75°F. The long summer day (17 hours in June, at 55° north latitude) compensates for the short growing season. Precipitation ranges from 15 to 20 inches per year and is concentrated in the summer months. Evaporation is low and, thus, this precipitation is sufficient for plant growth.

### (3) Humid Continental, Cool Summer

Most Canadians are familiar with this type of climate. There are at least 3 months

with a mean temperature of more than 60°F., with July being the warmest month. For 3 to 5 months temperatures drop below freezing. January is the coolest month, with temperatures ranging from -10°F. to 25°F.

The mean annual temperature ranges are high — usually greater than 50°F. Mean annual total precipitation varies from 15 inches in the prairie provinces to 50 inches in Newfoundland. It is evenly distributed throughout the year.

### (4) Middle Latitude Steppe

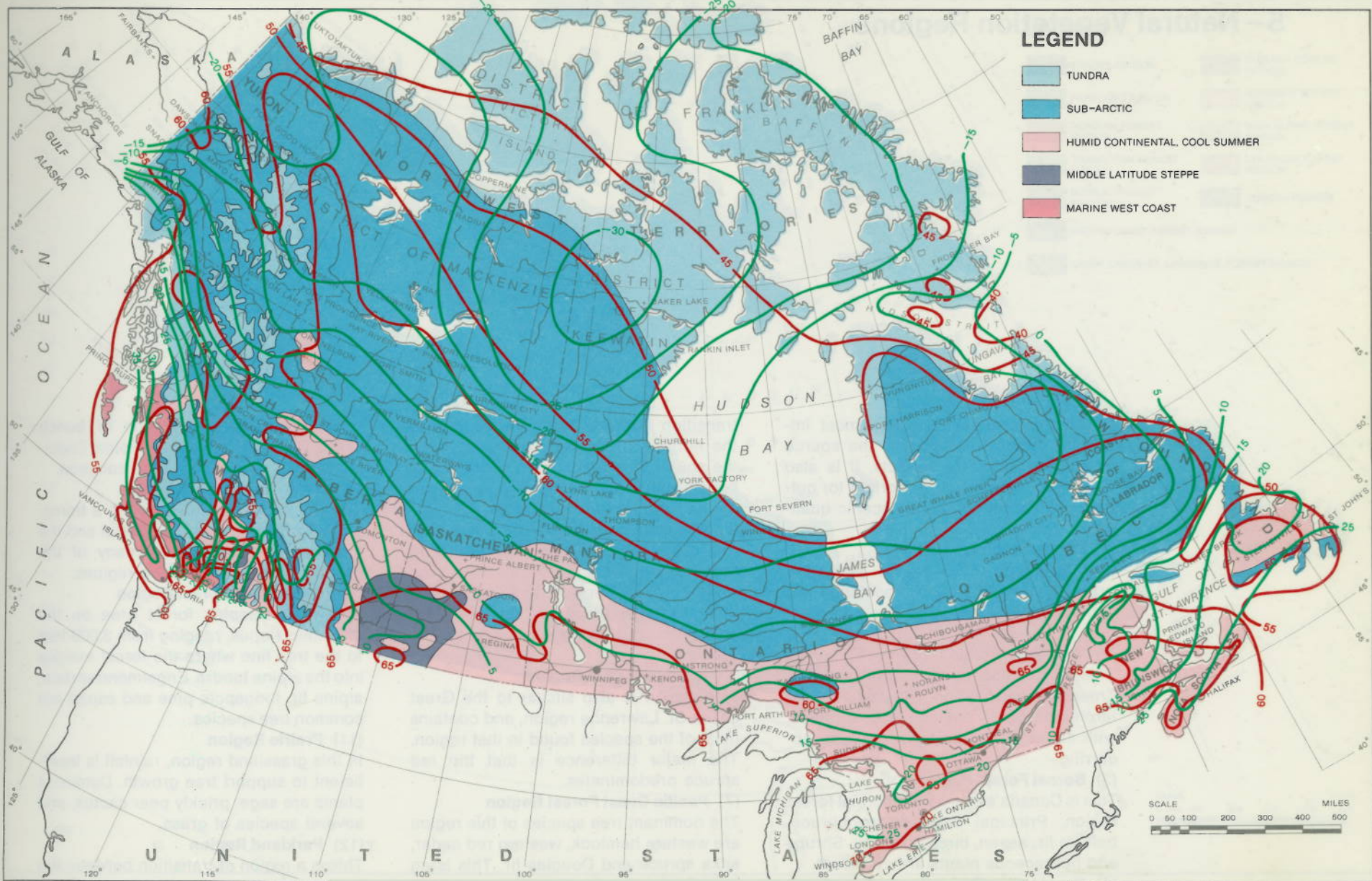
This is a transitional area between desert and humid areas. Its temperature characteristics are similar to those of the Humid Continental, Cool Summer region, although the extremes may be greater.

The region is semi-arid, with less than 20 inches of precipitation per year. Total rainfall is not dependable, and varies widely from year-to-year.

### (5) Marine West Coast

The Marine West Coast is greatly influenced by its proximity to the Pacific Ocean. Winter is mild, usually averaging above freezing, and the summer is cool. The mean annual temperature range is approximately 30°F. Total precipitation is extremely high — averaging between 60 and 100 inches per year — and is evenly distributed throughout the year.





**LEGEND**

- TUNDRA
- SUB-ARCTIC
- HUMID CONTINENTAL COOL SUMMER
- MIDDLE LATITUDE STEPPE
- MARINE WEST COAST

SCALE  
0 60 100 200 300 400 500  
MILES



## 5—Natural Vegetation Regions

Natural vegetation, Canada's most important natural resource, is the source of numerous forest products, it is also becoming increasingly important for outdoor recreation and for its scenic qualities.

### (1) **Tundra Region**

In this treeless, windswept area, the predominant varieties of vegetation are lichens, mosses, dwarf shrubs and grasses.

### (2) **Transition Forest Region**

This is a region of forest and barrens. Trees are scattered and stunted. Spruce, larch and birch are common varieties, with some shrubs and grasses also occurring.

### (3) **Boreal Forest Region**

This is Canada's prime commercial forest region. Principal species are spruce, balsam fir, aspen, birch and pine. Shrubs and herbaceous plants are abundant.

### (4) **Great Lakes-St. Lawrence Forest Region**

This region has more plant species than any other in Canada, and is essentially a

transition between the boreal forest to the north and the deciduous forests to the south. Pine, hemlock, cedar, maple, beech, yellow birch, oak, elm and ash are the dominant trees.

### (5) **Niagara Forest Region**

The Niagara Forest region is similar in composition to the Great Lakes-St. Lawrence region. There are few evergreens, other than pine. Chestnut, tulip tree, magnolia, hickory and walnut are additional species.

### (6) **Acadian Forest Region**

This region is also similar to the Great Lakes-St. Lawrence region, and contains most of the species found in that region. The major difference is that the red spruce predominates.

### (7) **Pacific Coast Forest Region**

The dominant tree species of this region are western hemlock, western red cedar, sitka spruce and Douglas fir. This is an important region for forestry.

### (8) **Montane Forest Region**

The typical montane landscape is dotted with park-like stands of ponderosa pine,

amidst a steppe vegetation of bunch grass. Douglas fir, lodgepole pine, Engelmann spruce, and aspen are common.

### (9) **Columbia Forest Region**

The Columbia Forest Region is a transitional forest between the coastal and the montane forests, sharing many of the species found in these two regions.

### (10) **Sub-Alpine Forest Region**

This is a complex forest area on the mountain slopes, ranging from 3,000 feet to the tree line where the forest merges into the alpine tundra. Engelmann spruce, alpine fir, lodgepole pine and aspen are common tree species.

### (11) **Prairie Region**

In this grassland region, rainfall is insufficient to support tree growth. Dominant plants are sage, prickly pear cactus, and several species of grass.

### (12) **Parkland Region**

This is a region of transition between the boreal forest and the grassland. Aspen, poplar, maple, bur oak, elm, ash, and numerous species of shrubs and grasses, are common.







## 6—Soil Regions

Canada has a great variety of soils, formed according to local conditions of bedrock, climate and vegetative cover. Generally, as one moves from south to north, soil depth and fertility decrease. Plate 6 shows the distribution of major soil types in Canada.

The *brown, dark brown, brown wooded, and black soils* are the most fertile prairie soils. The black soils are the best for wheat, as they have a higher moisture content. Incidence of tree growth increases from the brown to the black soils.

*Grey wooded soils* are not as fertile as the above soils. Developed under forest conditions, the soil is leached of many plant nutrients, and the carbonate layer close to the surface adversely affects fertility. Over-cultivation results in erosion in some hilly sections. However, with proper management, the arable portions can be quite productive. These soils are best-suited to vegetable growing and livestock rearing, but are not particularly suitable for wheat.

*High lime soils* are shallow, rocky and coarsely textured. They are poor for agricultural use, because of a high carbonate content. Once cultivated, they are now reverting to forest.

The *brown podzolic, grey brown podzolic, brown forest and dark grey gleisolic soils* are primarily derived from calcaereous parent material. With the ex-

ception of sandy areas, the land is fairly fertile, supporting mixed crops and livestock rearing. Sandy soils are generally used for tobacco. Some areas of imperfect drainage are unleached and, when drained, these are the most productive of this soil group. When forested, these soils support a mixed forest.

*Podzol soils* cover a large part of the country. These are leached acid soils which, where underlain by the Canadian Shield, are shallow and coarsely textured. Heavy leaching of plant nutrients occurs as a result of the wet climate. The coniferous forest cover results in the soil being highly acid. Under cultivation, there is a danger of soil exhaustion. However, if careful attention is paid to maintenance of soil, many crops can be grown satisfactorily, where climatic conditions are favorable. Podzol soils are best suited to forest, ranging from mixed forest in the south to coniferous forest in the north. This area is one of the best commercial pulp forest zones in Canada. Where underlain by the Canadian Shield, the soil is usually shallow and coarsely textured.

*Mountain soils* are extremely complex. Many different soil types can be found in a very small area. Brown, dark brown, black, grey wooded and podzol soils all occur. To the north, sub-Arctic soils are prevalent. Most mountain slopes are too steep for normal soil development. A

significant amount of land is agriculturally productive in the warmer south.

*Alluvial soils* tend to be fertile when properly drained. They are usually composed of sand and silt which, when associated with water or permafrost, produce undesirable conditions for agriculture or construction.

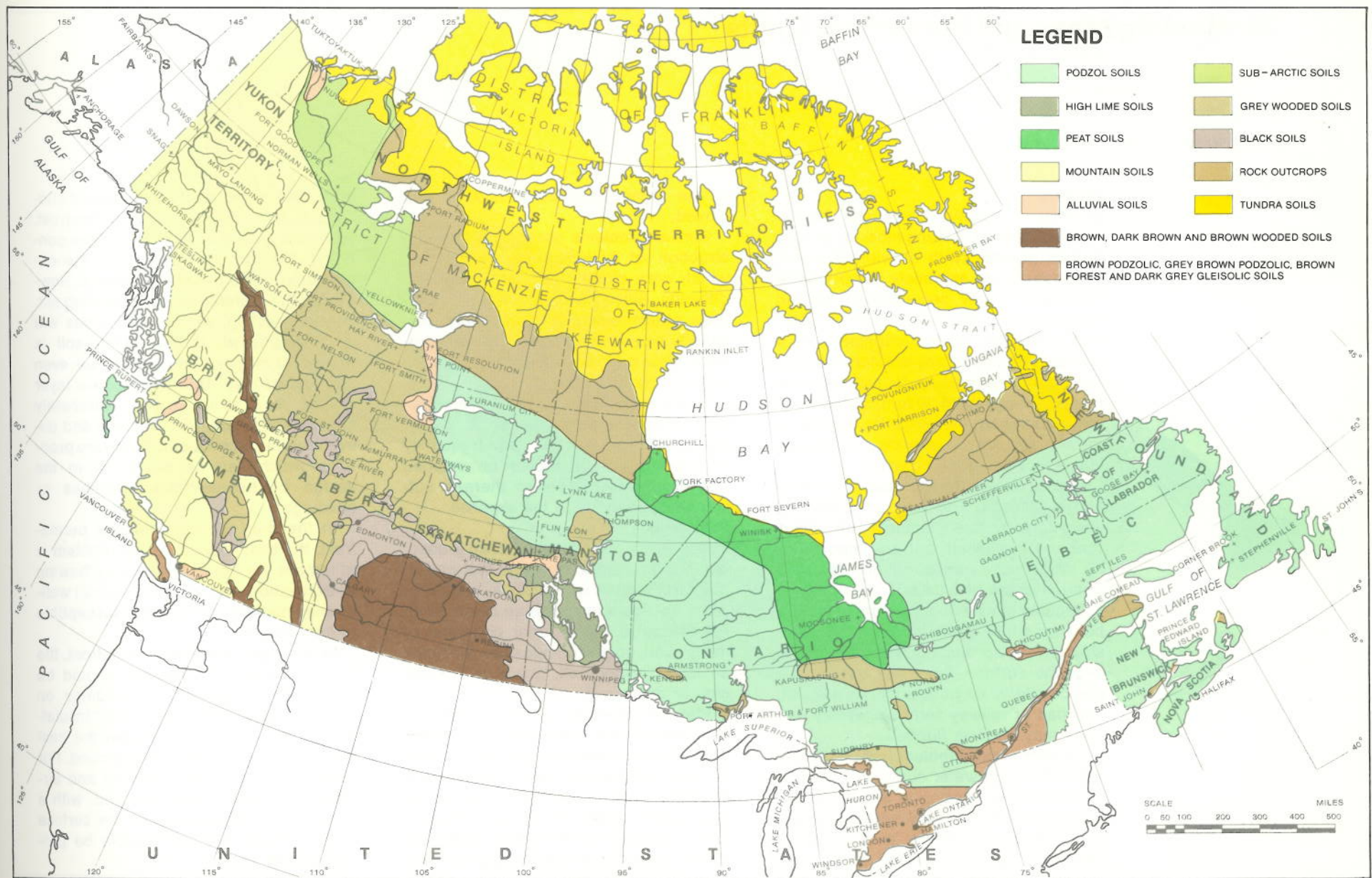
*Peat soils* could support some agriculture if drained but, in northern areas, the harsh climate renders them virtually useless for crops. They are difficult to build on, particularly when underlain by permafrost.

*Sub-Arctic soils* are thin and poorly developed. The climatic regime in the area slows the soil-forming process considerably. There are a few pockets of potentially arable land but, for the most part, this area is low in productivity. Rock outcrops and peat are extensive.

*Tundra soils* are little more than weathered parent material. Vegetation is sparse, and muskeg and permafrost are extensive.

Areas of *rock outcrop* have been severely glaciated, with the result that pockets of soil occur only in low-lying areas. Minimal agriculture is possible, as is the case for sub-Arctic soils. A certain amount of forest is supported. In the zone of permafrost, rock outcrops are perhaps the most favorable for construction.







## 7—Muskeg Areas and Permafrost Limits

### Muskeg

Muskeg or organic terrain may be described as a mat of living mosses, sedges and/or grasses (with or without trees), underlain by an extremely compressible mixture of partly decomposed organic material, which has a high water content and a very low bearing capacity (i.e., it is unable to support any substantial load). The depth of a muskeg deposit may vary from a few inches to 20 feet. The mineral soil underlying the organic deposit is usually clay, silt or a silty clay. Occasionally, it may be sand or gravel.

Plate 7 shows the distribution of muskeg in Canada. The area is subdivided according to the frequency of occurrence. It is difficult, but not impossible, to construct transportation facilities through areas of muskeg.

Organic terrain does not provide a firm base for either a railway or a road. Construction using earth or rock fill spread over the surface, squeezes out the organic material on both sides. As a result, the road or railway settles unevenly and parts may become flooded.

Another major problem is frost. Freezing of the high water content of the soil causes severe heaving in the winter.

There are three main ways to construct a transportation route over muskeg. These are: (a) float the road on the muskeg; (b) stabilize the muskeg by mechanical or chemical means; (c) remove the unstable material and replace it with fill. Local conditions generally dictate which

of the above methods should be employed.

Similar problems occur with the construction of buildings on muskeg, in which case settling is again the major difficulty. Since muskeg is not a continuous phenomenon, it is generally possible to select a location which will minimize these difficulties. Buildings can also be supported by piles.

Technical problems can be overcome, but construction on muskeg is costly. Consequently, areas with high frequency of organic terrain should be avoided wherever possible, unless there is sufficient cause to justify the expense.

### Permafrost

Permafrost, or perennially frozen ground, is the term used to describe that part of the earth's crust which, for a number of years, retains a temperature below 32°F. Permafrost is the thermal condition of the ground, not the composition, and may be found in bedrock, gravel, silt, sand, clay or muskeg.

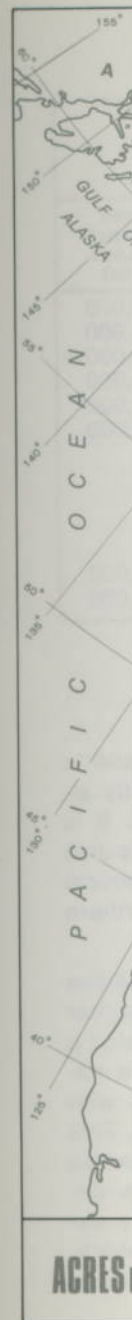
Plate 7 shows the southern limits of continuous and discontinuous permafrost. Continuous permafrost, which may be hundreds of feet thick, describes a condition where permafrost is found everywhere under the surface. Discontinuous permafrost describes a condition where permafrost is interspersed with areas of unfrozen material. In the southern part of the discontinuous zone, permafrost occurs as scattered patches, a few feet thick. With the exception of the

northern fringes, most of the area of Mid-Canada is of discontinuous permafrost. With rock, gravel or sand, the frozen condition does not seriously affect the engineering properties of the material. However, if the material is water-bearing silt, clay or muskeg, serious difficulties will be encountered. If the frozen soil is thawed, it may not be able to bear even the lightest load. Due to an active layer in the permafrost which alternately freezes and thaws, frost heaving and uneven settling often occur. These are problems which can be overcome in the design of transportation facilities or buildings.

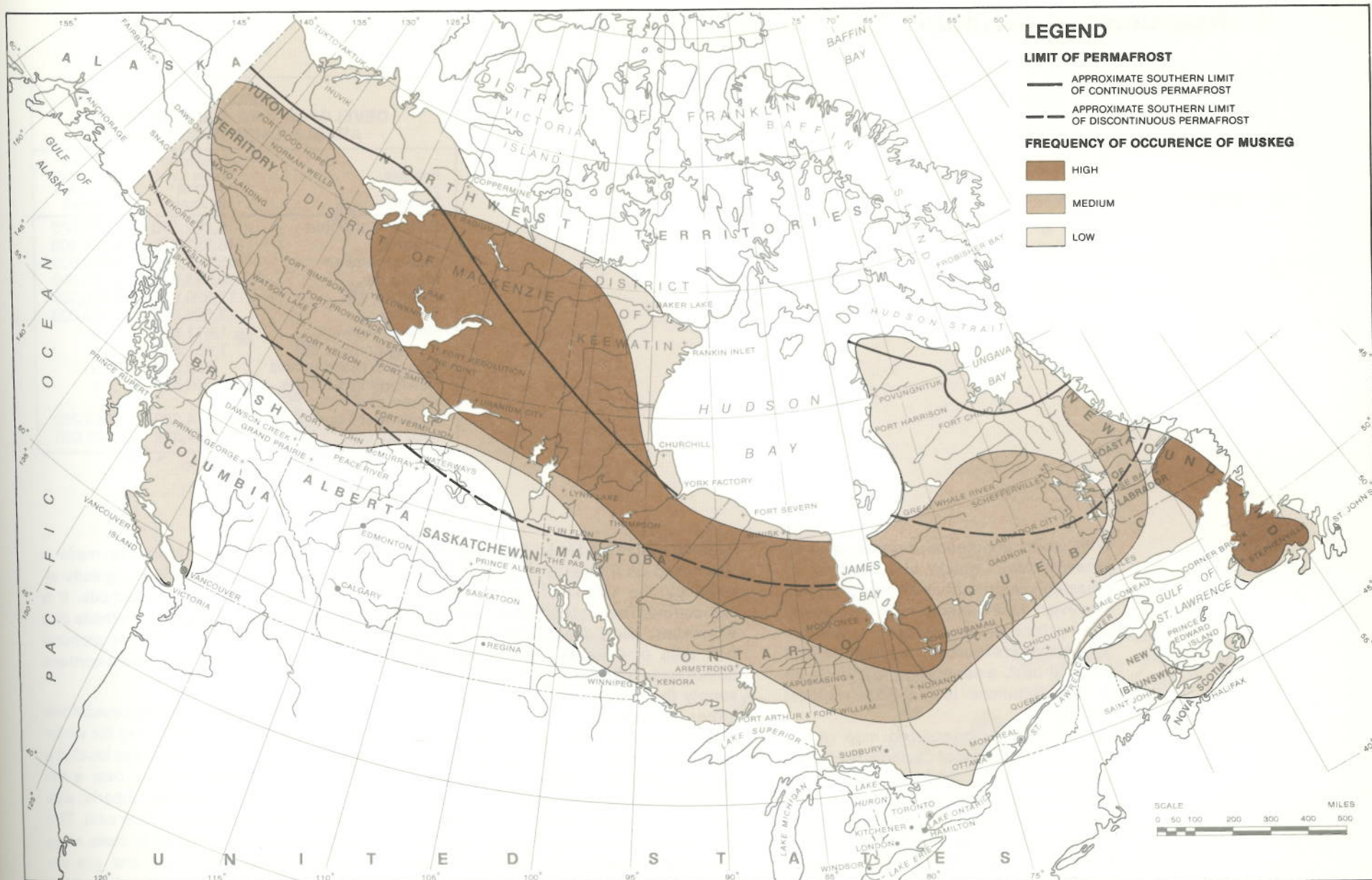
In the area of discontinuous permafrost, the best solution to the problem is to remove the frozen material by thawing or excavation, and to replace it with well-drained material which is not susceptible to frost action.

In areas of continuous permafrost, the frozen condition of the soil should be preserved by supporting buildings on piles well above the surface, and insulating the floor, thereby reducing the heat flow from the building to the ground. For construction of roads, railways and airstrips, fill methods can be used, with a minimum of disturbance to the surface cover. Proper drainage should be provided in all cases.

Although muskeg and permafrost can present serious problems, modern technology is able to overcome many of these difficulties.









## 8—Resources: Agriculture

**TABLE 1  
DEVELOPED AND UNDEVELOPED  
ARABLE LAND IN CANADA**

Province or Territory	Developed Arable Land — 1966* (in acres)	Estimated Undeveloped Arable Land (in acres)
British Columbia	5,292,310	2,010,000
Alberta	48,982,875	10,328,000
Saskatchewan	65,409,363	1,000,000
Manitoba	19,083,817	3,750,000
Ontario	17,826,045	8,000,000
Quebec	12,886,069	1,003,000
New Brunswick	1,811,695	a
Nova Scotia	1,851,895	a
Prince Edward Island	926,978	a
Newfoundland	49,513	a
Yukon and Northwest Territories	4,286	354,000
<b>CANADA</b>	<b>174,124,846</b>	<b>26,445,000</b>

\*Source: 1966 Census of Canada.  
a—Statistics not available

With world population increasing at its present rate, Canada will become increasingly important as a source of food. However, Mid-Canada must be developed principally on the basis of its non-agricultural resources. Agriculture will have, at best, a supporting role because of the limitations imposed by regional factors.

Plate 8 is a generalized map of the agricultural regions of Canada. Occupied agricultural land, concentrated in the southern part of the country, covers about 7.5 percent of the total land area. In eastern Canada, the raising of livestock is the most important agricultural activity, while the growing of grain, particularly wheat, predominates on the prairies.

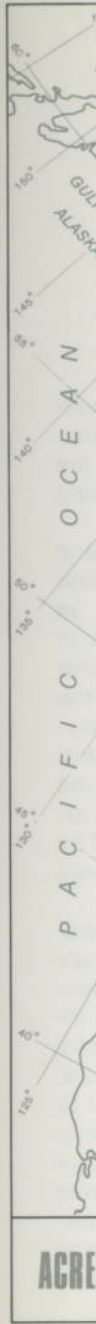
The circles on Plate 8 represent unde-

veloped arable land in Mid-Canada. They are based on figures (see Table 1) supplied by the Canadian Department of Agriculture. These statistics indicate that, in western Mid-Canada and in the clay belt area of Ontario and Quebec, sufficient undeveloped arable land exists to supply the local food requirements of a larger population.

More locally produced food, especially vegetables, would be an important incentive for northern settlement. Presently, food is shipped long distances from the area of supply. As a result, food is expensive. Although northern areas may not export agricultural products, they can be expected to meet the local demand — provided that the demand is sufficient to justify the capital investment required to clear and develop the land.

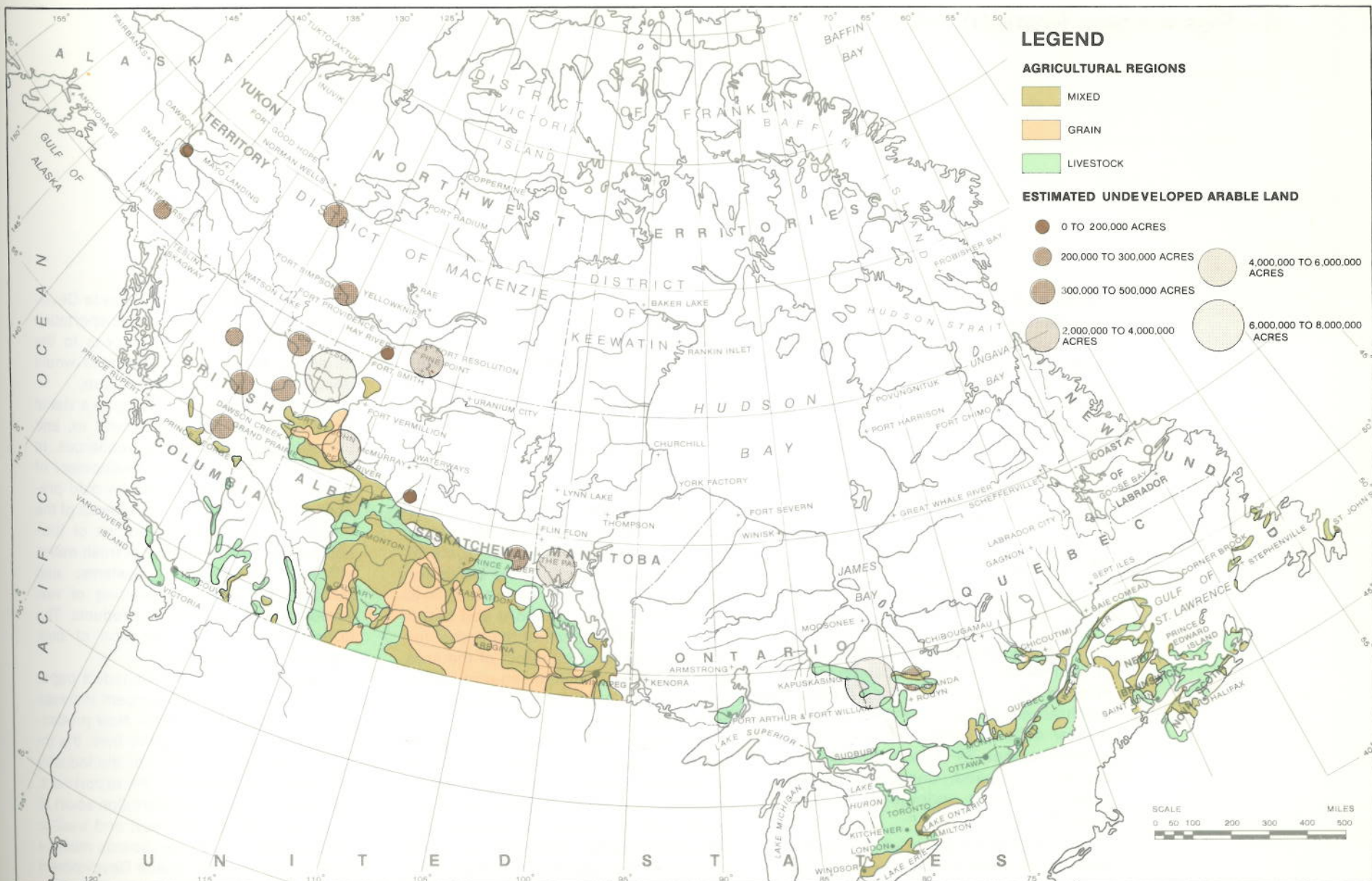
In the past, many advances made in agricultural technology have greatly altered traditional farming methods. It is reasonable to assume that methods also will be developed to extend economical crop growth beyond the present northern limits.

One of the most promising possibilities lies in the use of greenhouses for winter production. The Russians have located a major greenhouse complex over a natural gas field in Yakutsk, Siberia, with the gas providing heat at low cost. This technique can be adopted in those areas in Mid-Canada where oil and gas deposits are present. This is only one example of imaginative thinking which, coupled with technology, could be used to develop Mid-Canada.



AGRE







## 9—Resources: Forestry

Data presented at a recent World Forestry Congress indicated that the forecasted world demand for forest products cannot be satisfied without drawing heavily on Canada's softwood resources. Canada, with 22 percent of the world's supply, is one of two countries (the other is Russia) where the available softwood resources are extensively underutilized.

The demand for Canadian virgin wood-fibre, lumber and plywood is expected to increase 50 percent by 1975 — and more than 300 percent by the year 2000. Pulp and paper demand is expected to grow at a greater rate, increasing 59 percent by 1975.

The United States, Japan and Europe, in that order, are the most important markets for Canadian forest products. All three are presently investing capital in new mills in Canada, particularly in coastal regions. In response to increasing world demand, Canada's pulp and paper industry is undergoing rapid expansion.

An estimated \$1 billion will be spent in the next 10 years to build new pulp and paper mills in Mid-Canada. Northern British Columbia has a major share of this expansion, with four new mills under construction and six new mills proposed.

Three new mills in Alberta, one in Saskatchewan, one in Manitoba, four in Quebec, and two in Newfoundland, make up the remainder. In addition, large sums of money will be spent in the modernization and expansion of existing mills.

Many of the new mills now proposed or under construction will obtain all or a large portion of their raw material from the southern part of the boreal forest. This boreal forest stretches from Newfoundland across the continent and up into the Yukon Territory (see Plate 5). From the northern limit of the boreal forest to the tree line, a transitional area exists, which ends in tundra and barren land. The southern half of the boreal forest is heavily forested. Most of the area, about one-half million square miles, should be part of the Mid-Canada Development Corridor.

All recent developments along the southern edge of the boreal forest can be directly related to the existence of transportation facilities, particularly railroads. With the basic rail transportation system established, new mills can afford to develop their own local transportation systems to draw materials to their plants.

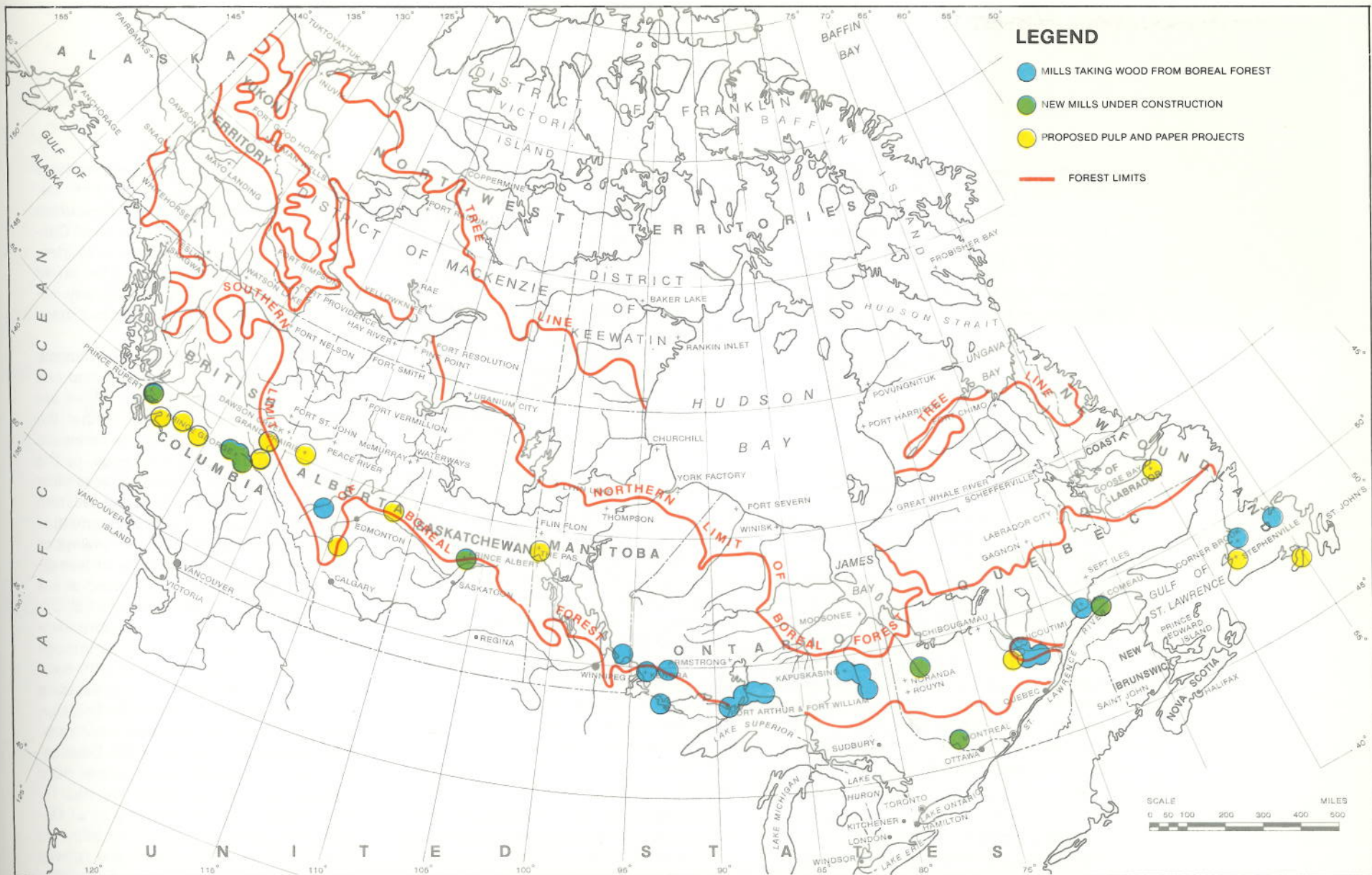
Of Canada's 968,000 square miles of productive forest land, less than one-third (312,000 square miles) is commer-

cially operated. The Mid-Canada Development Corridor, with its transportation facilities, would provide access to the other two-thirds of the area, and would open the forest to productive use.

If Mid-Canada is to develop in a viable manner, there must be access to, and utilization of, all available resources. In the forestry sector, the development of the pulp and paper industry would predominate. The major requirements of the industry are adequate sources of low-cost power; large supplies of fresh water; efficient transportation systems; and facilities for the bulk-handling of raw wood material and paper products. The critical factor is the creation of bulk transportation facilities.

Present forecasts for Canada's paper industry indicate a 500 percent increase in output by the year 2000. New production will undoubtedly come from the inland areas to the north. For the industry to remain competitive in the export field, efficient low cost transportation south to the United States and east and west to Hudson Bay and the seaboard must be available. The Mid-Canada Development Corridor would provide access to the forest resources, low-cost transportation to shipping points, and new and enlarged ports.







## 10—Resources: Minerals

The export of metal ores, concentrates and primary metals is an important asset to the Canadian economy. In 1954, exports of these materials amounted to \$726 million (including other non-organic minerals). That was 18.4 percent of all exports. By 1963, the value more than doubled to \$1,544 million, 22.1 percent of all Canadian exports.

Expansion of mineral production is felt strongly in the Canadian economy. The possibility of even greater expansion is promising, when the potential of Mid-Canada is examined. In the Northwest Territories, for example, almost the entire value of production is from metals.

Per capita consumption of metals in the world is rising steadily with the increasing technological applications. The present high demand for base metals is expected to grow, and the demand for other metals will increase at an accelerated rate as new uses are found for them. The rising population of Canada suggests a rapid increase in domestic metal consumption. It also suggests that Canada will be able to process the ores and engage in secondary manufacture to a much greater extent than at present.

The supply of ores in Canada appears virtually unlimited for many years ahead. Although growth of mineral production is great, many reserves exist which are at present too inaccessible to develop economically, but which would otherwise be marketable. With large markets and a plentiful supply, the key to attaining max-

imum returns from all this mineral wealth is transportation.

The minerals map (Plate 10) shows the distribution of types of metal-bearing rocks. The overlay indicates the location of existing mines and of known reserves.

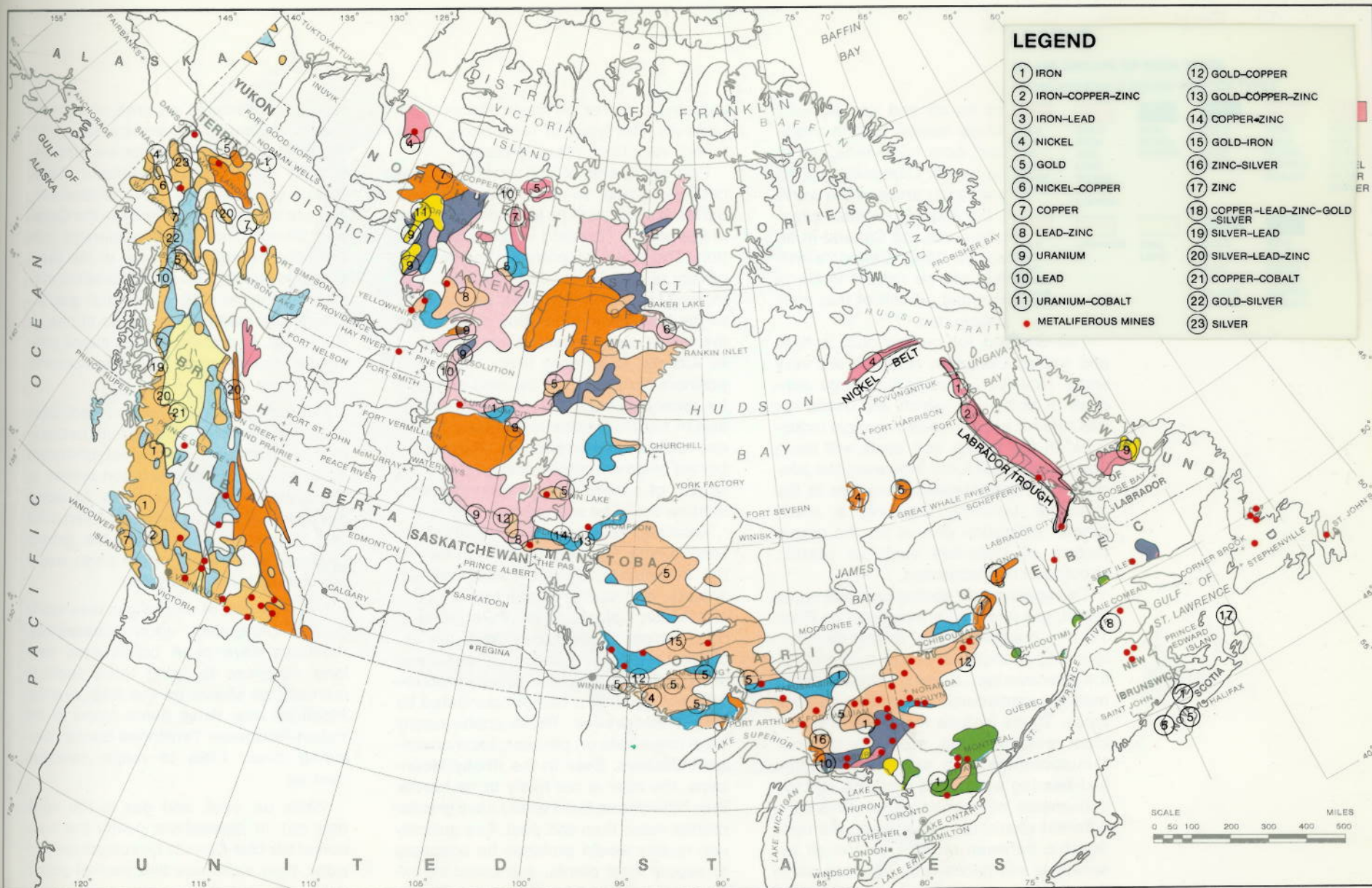
In terms of total value of production, only the nine most important metals are included on the map. Examination of existing mines and known reserves reveals that the metals are concentrated primarily in specific groups of rock types. The group depends on the metal involved. In various government publications on minerals, geologists are of the opinion that the relationship would generally hold true for other areas of Canada — as long as the rocks are in the same geological structure. It can also be assumed that the intensity of the occurrence of metal discoveries in unexplored areas of rock with mineral-bearing potential should be similar to that of areas of a similar rock type already being mined. The vastness of the potential reserves is strengthened by the observation that there are undoubtedly undiscovered reserves in presently mined areas. An example of this is the recent discovery of a large copper-lead-zinc deposit in the Timmins area.

Consequently, the various types of intrusive rocks in the Canadian Shield have been mapped, and further generalized to create an appreciation of the existence of "zones". The groups of metal ores found in each of the various rock types are listed on Plate 10.

Although these existing mines have been plotted from the Canadian Department of Energy, Mines and Resources map of "Principal Mineral Areas of Canada" (1966), no attempt is made to identify the metals on the map. The extent and value are not known with any accuracy, but it is safe to assume that these are substantial.

Certain patterns of distribution become apparent on examination of the map and overlay. Most of the existing mines are found in volcanic intrusions within the Shield. Concentrations of these mines are found along the southern edge of the Shield, or in areas of good accessibility to markets. In the eastern and western parts of the Shield, mine development is characterized by "fingers" of railways or roads, linking the mines more or less directly to the southern populated areas or to seaports. However, in central Ontario, where mines are much more numerous, an east-west route passes through the belt, linking many mines with each other and, eventually, with processing and shipping areas in the south. This supports the proposition that east-west transportation within a Mid-Canada Development Corridor would spur further mine development, as in central Ontario. Indeed, many deposits in this part of Ontario were discovered only recently, as a result of the construction of a railway line. Evidence points to the probability of future similar concentrations of activity further north, if transportation facilities served the area.







## 11—Resources: Fuels

World demand for oil and gas is rising rapidly and future market growth promises to be great, both in Canada and in the rest of the world. Competition from other major producing areas of the world is substantial, but a stable political situation and vast reserves put Canada in an excellent position. While Canada's natural gas market will be limited to North America, substantial growth of that market can be anticipated.

The demand for coking coal is high and known Canadian reserves are very small. However, Canada has large supplies of soft coals which are useful for fuel and for use by some chemical industries. In the future, soft coals will be in demand as local fuels. However, the possibility of technological advances in the chemical industry, enabling a much greater utilization of coal for the manufacture of materials such as plastic, should not be discounted.

The appropriate geological rock types for oil, gas and coal are mapped on Plate 11, in a manner similar to that used for mapping probable areas of future metal ore discoveries. Several other factors must be considered in relation to rock types. These include the location of ancient reefs, warping, proximity to other formations, and the extension of some fuel-bearing sediments from the surface underneath neighboring sediments of a different character. As a result, the relationship between rock types and oil reserves is not necessarily as close as in the case of mineral-bearing rocks.

Almost the entire northern extension of the Interior Plains (see Plate 3), is underlain by a geological formation, which

contains promise of future discoveries. However, the types of fuels likely to be found, vary from place-to-place.

Perhaps the most important fuel area in Mid-Canada is the Athabaska Tar Sands deposit, with its immense reserves of petroleum. This field is now in production. There is also potential for the discovery of oil and gas in large quantities in the Mackenzie lowlands, as far north as the Mackenzie delta. But, considering the vast known reserves still to be tapped in Alberta, it is more likely that these northern resources will be used primarily for local purposes. Oil and gas production in the Mackenzie area would not be economical on a large scale, unless supported by government subsidy. However, as part of a more diverse economy, production could be economical.

Possible coal-bearing formations in Mid-Canada appear to be limited to the Mackenzie lowlands and northern Alberta, with scattered patches in northern British Columbia, the Yukon, and in the Hudson Bay lowlands. With the exception of northern British Columbia and the Yukon, these areas will likely produce only soft coal — a fact substantiated by recent discoveries. These could supply local fuel needs or, perhaps, local chemical industries. Even in the Rocky Mountains, the coal is not likely to be harder than bituminous, but it would have greater market value than soft coal. The quantity and quality would probably be adequate to supply steel plants, and could be exported via accessible ports on the Pacific Ocean.

The Plate 11 overlay, which shows the location of existing wells and oil and gas

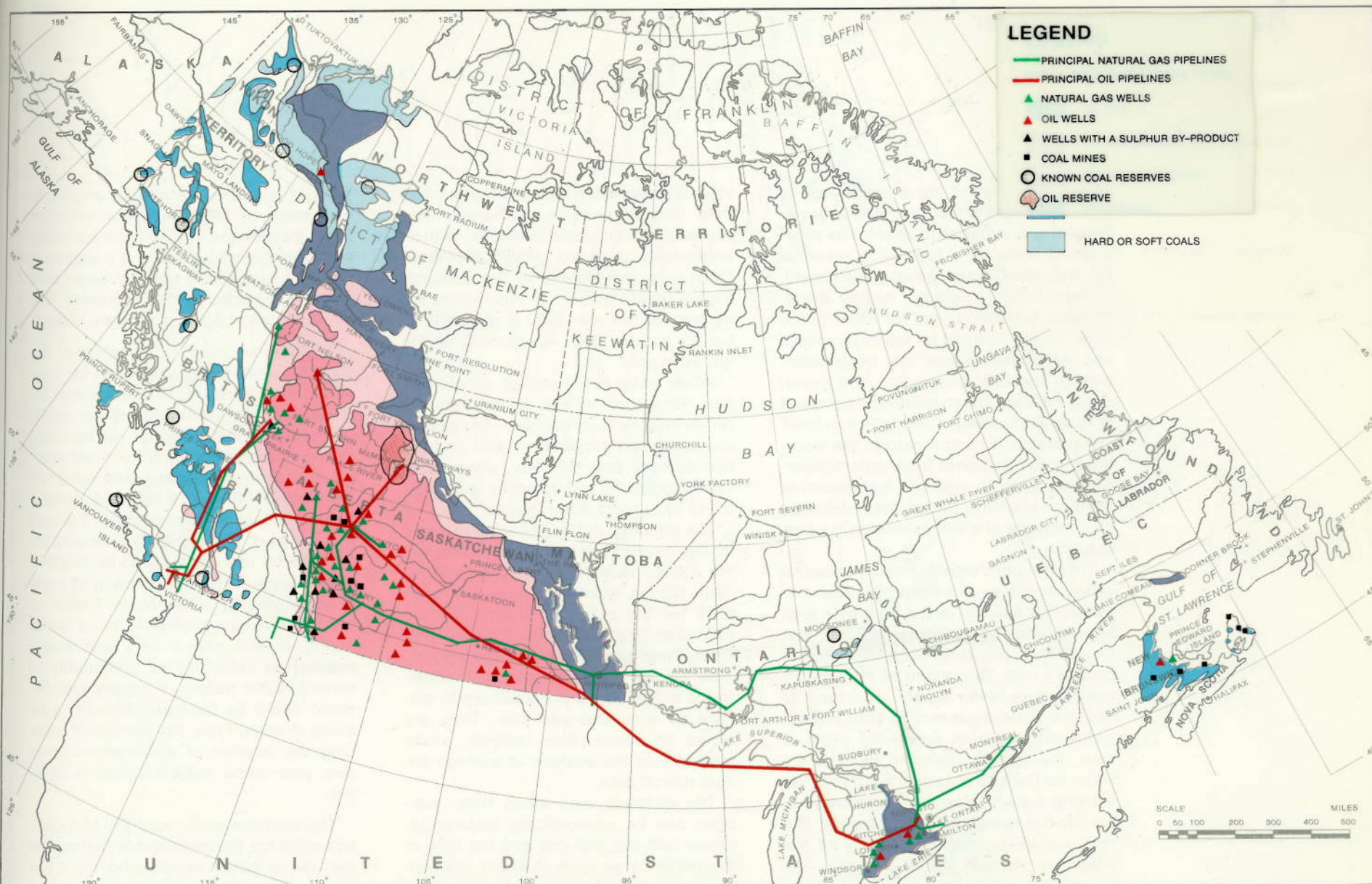
pipelines, indicates an area of concentration of natural gas wells close to the Rocky Mountains. Oil wells are also orientated in the western Interior Plains region, but these are more widespread, and are limited by proximity to the Canadian Shield. This fact considerably narrows the potential oil area in the Mackenzie lowlands. The same limitation may also be the case for natural gas, although the evidence is not as strong as it is for oil. At present, coal is mined principally near the more populated parts of the country.

Northern coal reserves have not been exploited to any large extent because they are inaccessible. The establishment of an adequate transportation system in Mid-Canada would do much to assist development of coal deposits. Even if the use of coal was localized, the growth of larger settlements in the north would warrant its development.

Development of oil and gas reserves is not as dependent upon accessibility. Pipelines have been constructed over long distances to bring these fuels to markets, as shown on the map overlay. Pipelines now serve fields close to the Yukon-Northwest Territories border, providing direct links to major southern centres.

While oil, coal, and gas in the north may not, in themselves, justify the creation of the Mid-Canada Development Corridor, their existence and market potential are such that they provide one more major economic factor supporting the establishment of the Development Corridor.







## 12—Resources: Water

Water, on which all life is dependent, is of critical importance in economic development and urban settlement. The presence of water in a locality is essential for industrial development, settlement, transportation, irrigation, energy development, recreation, and for other prime uses. As the demand for water increases and pollution reduces the fresh water supply, the task of locating and developing suitable water resources becomes critical. Fortunately, Canada is in a most favorable position in regard to the quantity and distribution of fresh water resources. However, to maintain that favorable position, planning for optimum development and use of water resources is a prerequisite.

The economic significance of Canada's water resources is substantial. Approximately 7.6 percent of the country's total area consists of fresh water bodies, and these resources in turn are estimated to be more than 25 percent of the world's fresh surface water supply. On a local or regional scale, there may be severe water problems but, from a national point of view, the total foreseeable demand for water for Canada is a small fraction of the existing supply. However, problems occur in the geographic distribution, the time variability, and the quality of the supply in relation to the demand. The location of extensive economic activity and major urban settlement should be in relation to the location of major water sources. This applies particularly to high

volume water-using industries — such as pulp and paper mills, refineries, food processing plants, and tanneries. With its anticipated dynamic growth, southern Ontario is an example of the demand-supply relationship — in this region, the demand in the year 2000 is expected to be no greater than 40 percent of the known supply.

When water is utilized for agricultural use, 50 percent of this water does not return directly to its source — because of evaporation, transpiration, and absorption into the soil. However, when water serves industrial and domestic uses, only a 5 to 10 percent water loss results.

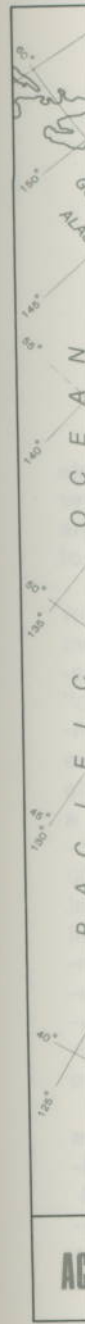
The principal drainage basins involved in the development of Mid-Canada are the Arctic, Hudson Bay, Pacific, and Atlantic Basins. Average annual water supplies for the principal watersheds are estimated from established run-off patterns. Plate 12 indicates the average annual discharges from principal watersheds in the country. Values are in millions of acre feet per year. They are based on stream flow records, where available, or the analysis of average annual run-off data.

The distance over which water supplies can be economically transferred, varies with the end use and the type of diversion. Large open channels are economically feasible over distances of up to 1,000 miles. Pipelines for limited industrial and domestic supply are economic only over shorter distances (e.g., a 4-foot

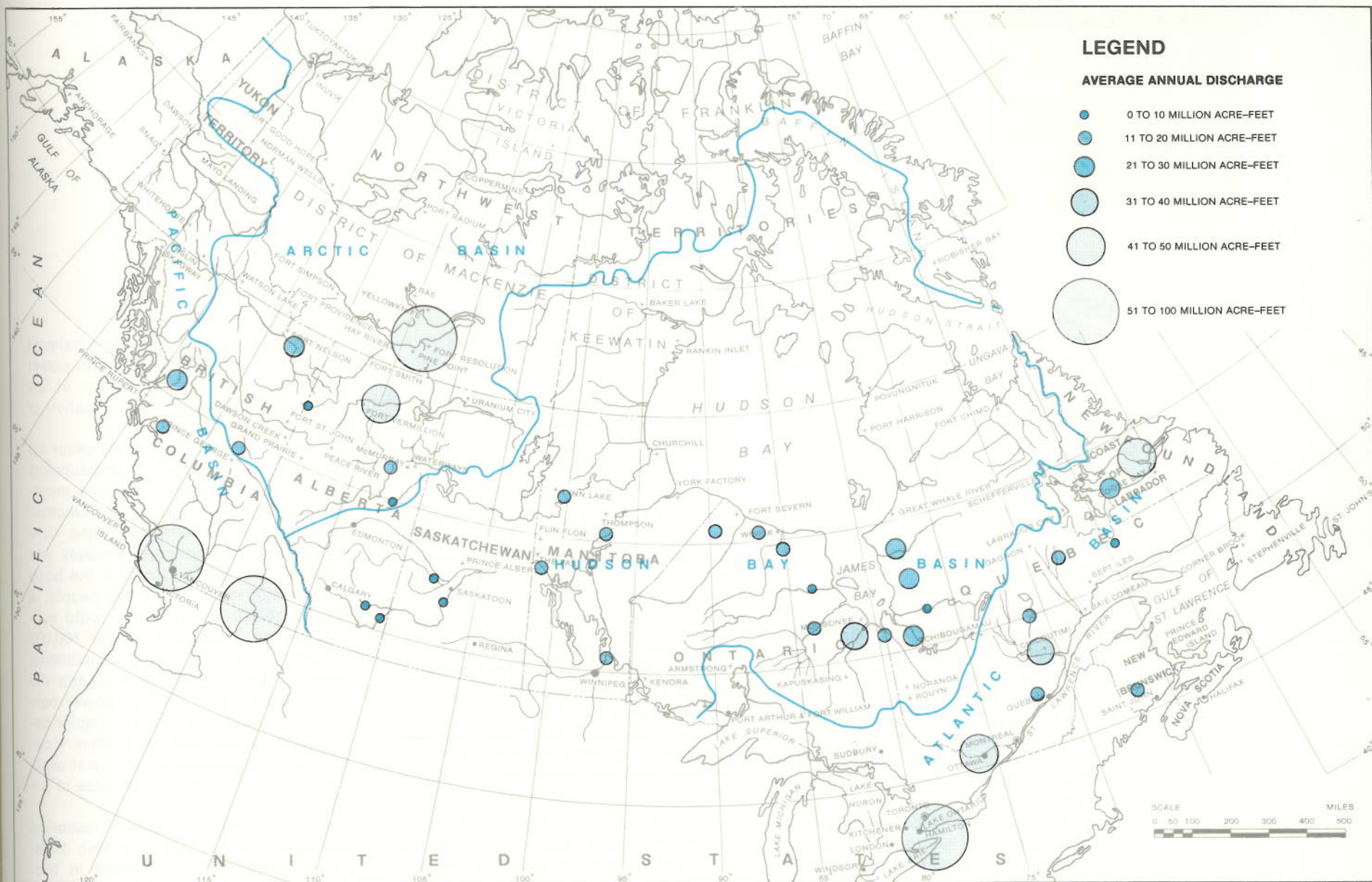
diameter pipeline is economic only up to a distance of 170 miles). For irrigation uses, the economic distances for water transport are also shorter. If pumping is required to maintain the discharge over horizontal sections, the economic distances should be approximately halved.

To establish general indicators of the size of communities which can be supported by the water supplies, several assumptions must be made. The per capita domestic demand for water will increase to approximately 0.2 acre feet per year. In larger centres, the per capita industrial demand will be about 8 times the domestic demand, or the equivalent of 1.6 acre feet per year. The water requirements for agricultural use are likely to be small in Mid-Canada, with the exception of parts of the Mackenzie River basin. Based on that criteria, an average annual water supply of one million acre feet would support an industrialized community of some 500,000 people, if supply and demand could be balanced through adequate storage. Thus, the wisdom of planning the location of development sites near year-round water supplies is obvious.

The available water supply in Mid-Canada outstrips the foreseeable demand of the several million people who might live in the region. Preliminary assessment of supply and demand indicated that large surpluses will exist even at an advanced stage of development.









## 13—Resources: Energy

Canada is richly endowed with immense water power resources. With the exception of the prairies, water resources of considerable magnitude are found in almost every part of the country. Quebec's water power resources are the most extensive, followed closely by those of British Columbia. In Mid-Canada, important water power sites await development. On the Yukon River and on the South Nahanni River in the Northwest Territories, preliminary investigations indicate a potential power generation of one million kilowatts. There are further indications that rivers draining the Keewatin District will contribute substantially to the total power potential of the Northwest Territories. In Labrador, at Churchill Falls, one of the country's largest power developments is being constructed. Here, as elsewhere in Canada, water power is of special importance to the development of natural resources.

In the Prairie Provinces, abundant reserves of coal, oil and gas can be used as fuel for thermal-electric plants, which would supply local power demands. With oil explorations ranging far down the Mackenzie River valley, the prospects for thermal-electric power are good — par-

ticularly with the development of high-voltage, long distance transmission. Water power is still the main source of electrical energy in Canada. But, in recent years, a marked trend to thermal-electric development has become noticeable. In the future, it is expected to become the main power supplier.

Thermal-electric plants lack flexibility in terms of load conditions, but do have flexibility of location. The converse applies to hydro-electric developments. These are more flexible in operation, but their locations are tied to water sources.

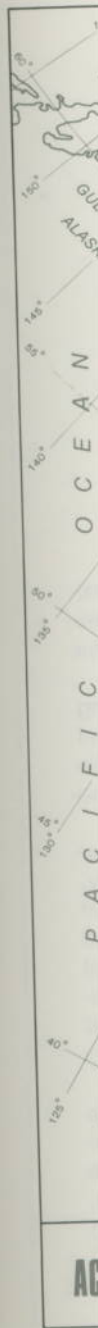
Nuclear power is a relative newcomer, which will increase in importance if capital and fixed costs can be lowered. Since Canada has a plentiful supply of the raw materials used in reactors, there is no doubt that nuclear power will play an important role when development in Mid-Canada becomes more intensified.

Now, however, developed water power in Mid-Canada is only a fraction of the potential. In January, 1965, the installed generating capacity in Canada was 20.3 million kilowatts. The undeveloped water power has been conservatively estimated at 63.5 million kilowatts.

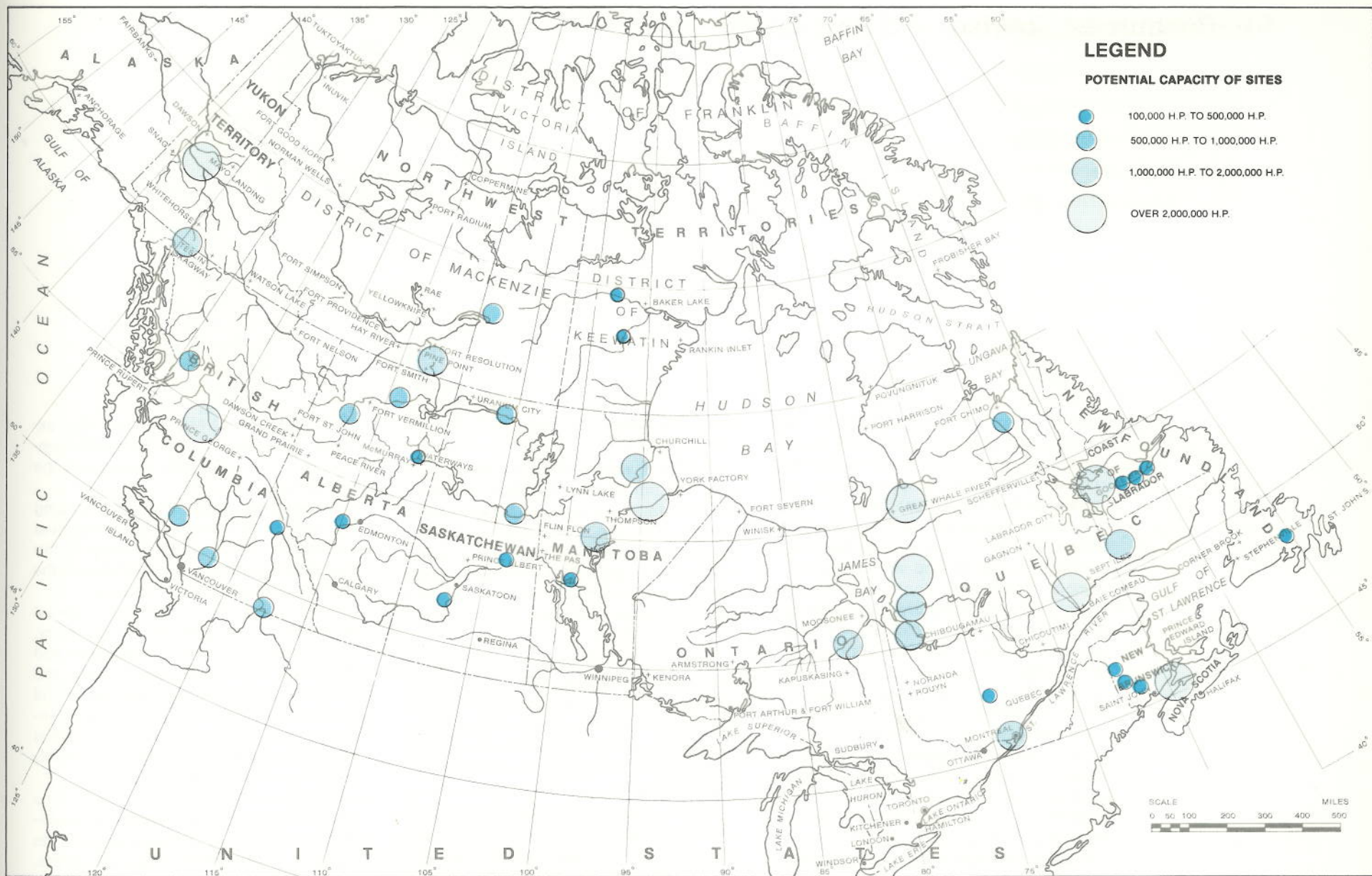
Plate 13 shows the approximate amounts of undeveloped water power available in the major regions of the country. It gives a broad indication of the development potential.

The average power consumption for mixed industrial and urban development in Canada is approximately one megawatt per 1,000 people. If an "all-electric" community is contemplated, the consumption would be approximately one megawatt per 300 people. On the basis of one megawatt per 1,000 people, a source of 100,000 kilowatts could support, on an average, a city of 100,000 people, depending on the industrial base. As the cities in Mid-Canada will probably be based on high-power consumption industries, the per capita demands for power will be greater. However, with an abundance of power available, there is no limit to the size of the cities.

When undeveloped power resources are related to possible economic development and urban settlement in Mid-Canada, there is evidence that the capacity and distribution of electric power will support any anticipated development.







**LEGEND**

**POTENTIAL CAPACITY OF SITES**

- 100,000 H.P. TO 500,000 H.P.
- 500,000 H.P. TO 1,000,000 H.P.
- 1,000,000 H.P. TO 2,000,000 H.P.
- OVER 2,000,000 H.P.



## 14—Resources: Tourism and Recreation

Tourism plays an important role in the development of Mid-Canada. It is one of the continent's major growth industries and one of Canada's most valuable U.S. dollar-earning industries. The opening of a Development Corridor across Mid-Canada will provide access to new recreational resources and will create new tourism development potential. Among the inherent problems presently existing for tourist development of Mid-Canada, are seasonality, distance from major urban areas, and a general public ignorance of the region. However, these can be overcome, and the tourist industry can provide an important income increment to aid in the justification of development of many multipurpose projects, whether these are natural resource developments or a Mid-Canada Development Corridor.

Tourist elements with potential drawing power in Mid-Canada are mapped on Plate 14, including areas of undeveloped scenic potential. Basically, mountains and water are the two landscape

elements which are most attractive to tourists.

Northern waters are relatively cold, and not particularly suitable for swimming, water-skiing, or other water sports. However, water is important for its scenic potential, especially when bordered by a rugged coastline. Much of the coast of Hudson Bay is flat and monotonous and, for that reason, is not included on Plate 14.

Fishing is a major recreational activity and is presently the prime tourist attraction in Mid-Canada. As there are thousands of lakes, rivers and streams in the area, the potential for the further development of fishing as a tourist attraction is great.

Hunting is also important. Animal species which will attract the hunter to the Mid-Canada include: moose, grizzly bear, black bear, mountain sheep, mountain goat, and deer.

"Hunting with a camera" is growing in popularity every year. The parks and

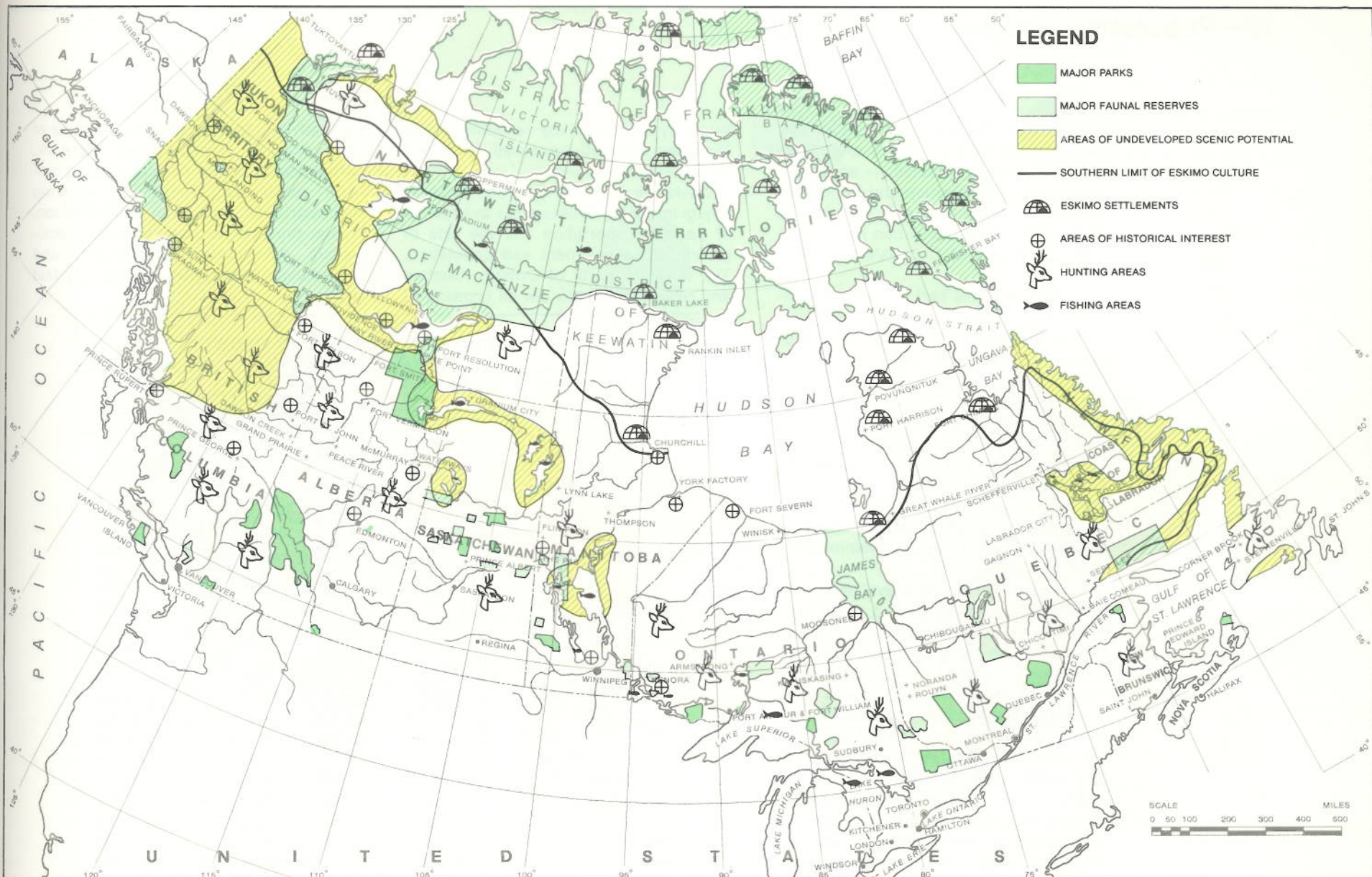
faunal reserves of Mid-Canada offer excellent opportunities for the camera enthusiast — and for the camper and the naturalist.

Canada has a rich history. Fur trading led to the exploration and eventual opening-up of the country. Many of the old fur trading posts are marked on the map as areas of historic interest.

The Klondike Gold Rush was one of the most colorful periods in our history. The names of Dawson, Whitehorse and Skagway are synonymous with the quest for gold. Today, tourists travel hundreds of miles on the Alaska Highway to see these areas. The potential of the Klondike region can undoubtedly be further developed.

Unique to the north are the Eskimo settlements. As more interest in northern culture is generated in the populous parts of North America by the press, television, and the impact of Eskimo sculpture and prints, more people will want to visit the home environment of this native race.







## 15—Population

People are the basic element in the resource development of any area. Canada is sparsely populated — an examination of the distribution and the rate of population growth, reveals that almost 89 percent of the population live in less than 15 percent of Canada's total land area.

To illustrate this fact, Canada is divided into two zones (see Plate 15), based on Gajda's paper "The Canadian Ecumene — Inhabited and Uninhabited Areas", which appeared in the *Geographical Bulletin* Volume 15. The area south of the heavy black lines on Plate 15 corresponds closely to Gajda's Zone I. Basically, this is an area of reasonably continuous settlement. The area north of the black lines is referred to as Zone II, within which settlement is unevenly distributed, with large uninhabited regions.

The nature of the data available from the Canadian census forced some generalization from Gajda's map and, thus, some areas do not give an accurate picture. This is the case with the interior of the Gaspé Peninsula and central New Brunswick. For Ontario, the Prairie Provinces and British Columbia, however, fairly accurate pictures of the population distribution are presented.

Zone II is an area of discontinuous settlement, often referred to as "the wilderness" or "the land of cold weather and black flies" — yet there are over two million people living in the region. Almost one-half of these people (977,300) live in Ontario and Quebec. It is noteworthy that these two provinces are

primarily supported by resource industries, and that both have well-developed transportation systems.

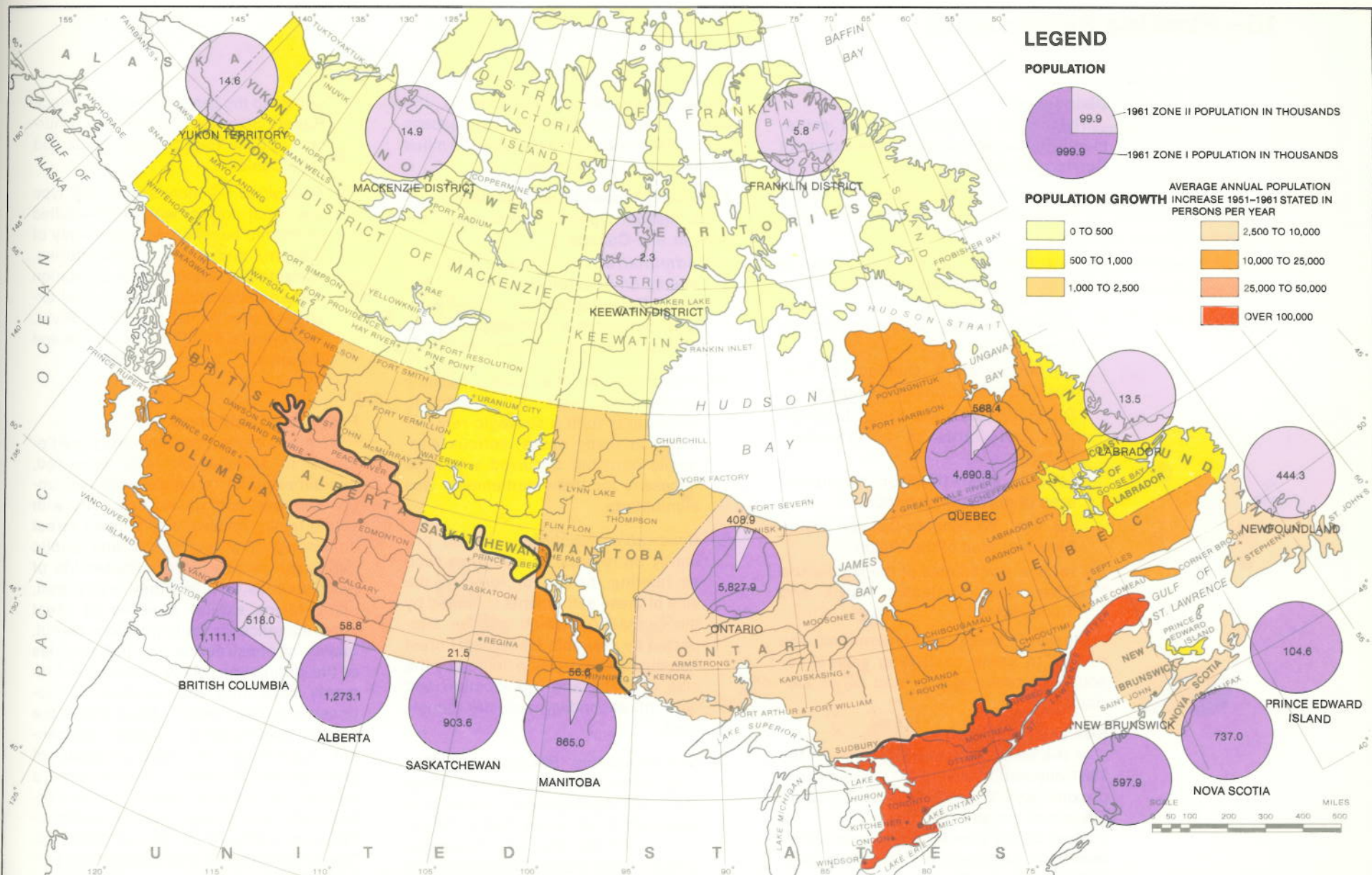
Obviously there is a relationship, in any given area, between the availability of good transportation and the rate of growth of development and population. The northern parts of Ontario, Quebec and British Columbia are all growing at

a relatively rapid rate, partly because of the existing transportation network, which facilitates the development of natural resources. Where the existing transportation has been multifunctioning, rather than single resource based, economic development, settlement, and population, have grown at relatively fast rates.

**TABLE 2  
POPULATION: DISTRIBUTION AND GROWTH  
CANADA — 1951-1961**

Province or Territory	Zone	1961 Population	Zone as a Percent of 1961 Total	Percent Increase 1951-1961	Average Annual Increase 1951-1961
British Columbia	I	1,111,115	68.2	40.1	31,786
	II	517,967	31.8	39.3	14,601
	Total	1,629,082	100.0	39.8	46,387
Alberta	I	1,273,108	95.6	40.9	36,951
	II	58,836	4.4	63.9	2,293
	Total	1,331,944	100.0	41.8	39,244
Saskatchewan	I	903,645	97.7	10.7	8,749
	II	21,536	2.3	38.2	596
	Total	925,181	100.0	11.2	9,345
Manitoba	I	865,014	93.9	17.9	13,146
	II	56,672	6.1	31.9	1,369
	Total	921,686	100.0	18.7	14,515
Ontario	I	5,827,172	93.4	36.4	155,686
	II	408,920	6.6	25.3	8,169
	Total	6,236,092	100.0	35.6	163,855
Quebec	I	4,690,765	89.2	29.4	106,559
	II	568,446	10.8	32.0	13,794
	Total	5,259,211	100.0	29.7	120,353
New Brunswick	Total	597,936	100.0	15.9	8,224
Nova Scotia	Total	737,007	100.0	14.7	9,442
Prince Edward Island	Total	104,629	100.0	6.3	620
Newfoundland	Total	457,853	100.0	26.7	9,643
Yukon	Total	14,628	100.0	60.8	553
Northwest Territories	Total	22,998	100.0	43.7	699
CANADA	I	16,207,376	88.9	30.1	375,193
	II	2,030,871	11.1	30.7	47,689
	Total	18,238,247	100.0	30.2	422,882







## 16—Existing Settlements

### Distribution:

The major concentrations of settlements in the Mid-Canada Development Corridor are found in:

- (1) the valley of the upper Mackenzie River and the Great Slave Lake area, and
- (2) the triangle of mineral resource towns centred around Noranda in the east, Kapuskasing in the west, and south to Sudbury. Lesser agglomerations exist in:
  - (a) north-eastern Quebec, at Wabush, Labrador City and Gagnon,
  - (b) the Pickle Lake-Sioux Lookout-Red Lake area of north-western Ontario,
  - (c) The Pas-Flin Flon-Thompson area of northern Manitoba,
  - (d) the Whitehorse-Dawson City-Skagway area of the Yukon
  - (e) the settlements of the Mackenzie River delta, including Inuvik and Tuktoyaktuk.

Most of these agglomerations are related to areas containing several resources, transportation and other services.

### Size and Population:

In the entire Northwest Territories, the 1961 population was 23,000 persons, approximately 60 percent of whom were Eskimo or Indian.

Most of the present towns and settlements in Mid-Canada have less than 5,000 residents. Few exceed a population of 10,000. Scattered in approximately 60 settlements, the communities range in size from 50 to 3,500 persons. In the re-

source towns of northern Ontario, the largest single concentration is in excess of 150,000 persons, in a triangle 150 miles by 200 miles by 175 miles.

### Functional Types of Communities:

Six distinct types of communities appear in Mid-Canada.

- (1) *Administrative* — These depend mainly on government services, and contain a great number of civil servants. Settlements of this type include Frobisher Bay, Inuvik and Fort Smith.
- (2) *Defence* — In the past, defence communities were established to temporarily fulfil a strategic requirement. In many cases, serious economic hardship occurred when the necessity for these settlements was eliminated.
- (3) *Renewable Resource* — Based primarily on renewable resources such as hunting, fishing or forestry, the size of these settlements is limited by the population which can be supported by available resources. Forest industry towns are also limited by the size of mills, and the location and type of secondary industry generated.
- (4) *Non-Renewable Resource* — This category includes most of the mineral resource development towns, the existence of which are tied to the extent of, or demand for, resources. Cobalt, Pine Point, Thompson and Mayo are examples.
- (5) *Port Centres* — These are settlements which serve as transportation

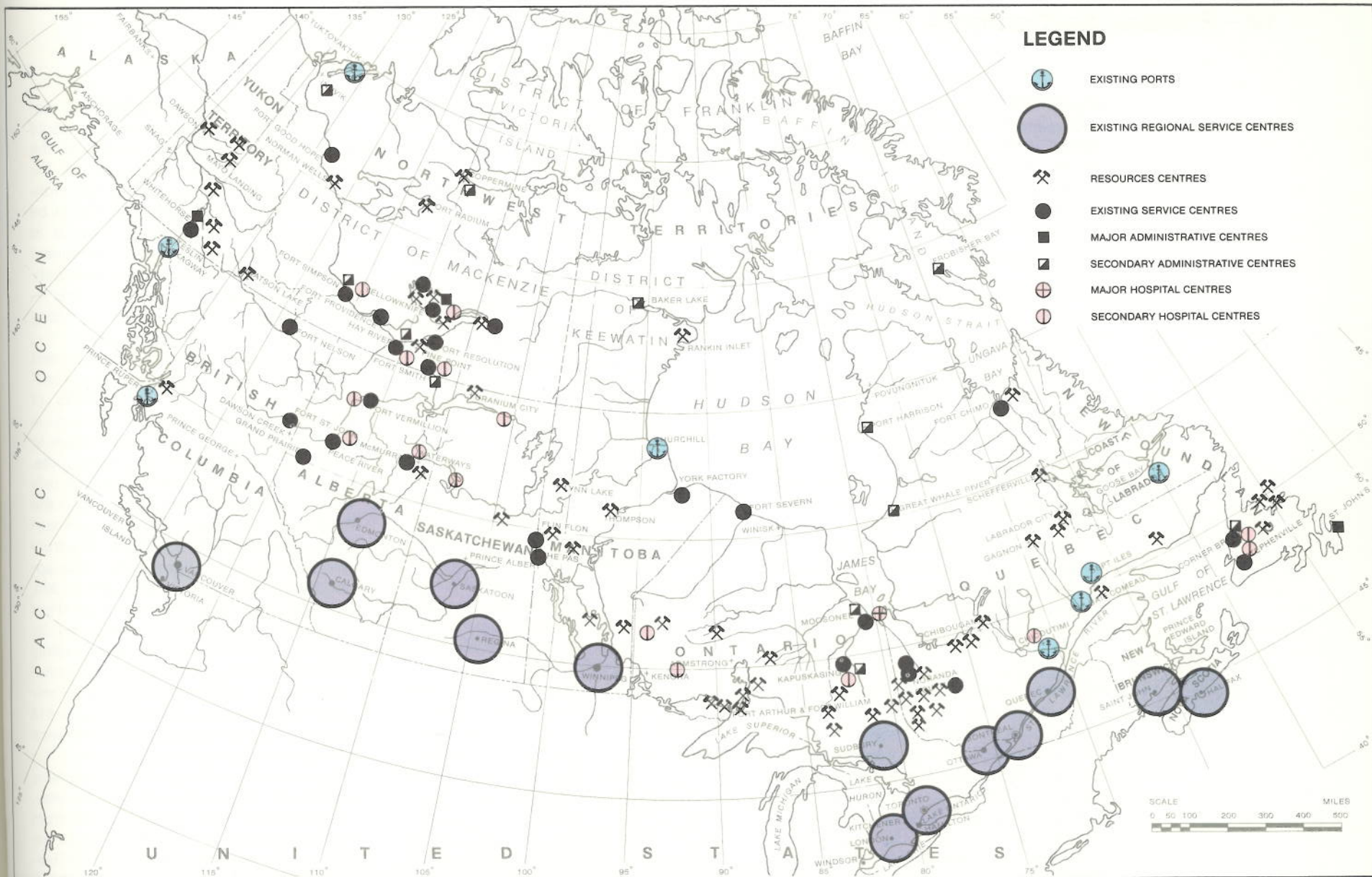
outlets to the sea, and include: Prince Rupert, Skagway, Tuktoyaktuk, Churchill, Goose Bay, Seven Islands and Baie Comeau.

- (6) *Diversified* — Included in this type are most towns with a diversified economic base, consisting mainly of tourism, secondary manufacturing, extractive industries, transportation and administration. Some typical examples are Whitehorse, Hay River, Yellowknife, Flin Flon, Cochrane and Noranda.

### Problems of Settlement

In most cases, contemporary settlements in Mid-Canada are dispersed, two-dimensional arrangements of unpaved roads and unserviced lots, with single-family houses, and a main street consisting of a few stores and public buildings. Because of the limited life of the resources to which they are related, many towns exhibit a sense of great impermanence in their physical layout, quality of construction and the attitudes of the population. Many resource settlements have little socio-economic relationship to their region. Most towns are smaller than 10,000 population, and cannot support an extensive program of services and facilities. To overcome a number of these problems, some corporations now provide subsidized housing and company-sponsored facilities. The introduction of new concepts of settlement can alleviate many of the physical and social problems inherent in the existing resource-based towns in Mid-Canada.







## 17—Transportation: Railways

Access to Mid-Canada is the key to development. In the past, the climate and nature of the terrain have rendered physical movement difficult and costly, and have kept most of the region remote from major world markets. Therefore, if the wealth of resources in Mid-Canada is to be developed, adequate transportation is crucial.

According to a draft statement on research of northern transport, by the Arctic Institute of North America, there is, to date, no overall or all-inclusive survey of the total resource potential of the north, or of transport needs required to realize that potential. Of inestimable value would be a major study which collated all relevant knowledge concerning the transportation facilities for the needed development of the economic potential of the north.

This study of a Mid-Canada Development Corridor attempts, in the broadest sense, to relate several aspects of resource development to various modes of transportation.

The pattern of existing rail transportation in Mid-Canada differs in several respects to the pattern in the southern areas of Canada. Strong east-west links in the south were established originally for political and military purposes, and only later for economic reasons. Current railway development, as it affects Mid-Canada, has the following characteristics:

- (1) It is more provincially than nationally oriented;
- (2) It has mainly evolved on the basis of single function requirements;
- (3) Single routes of transportation form

the general pattern, jutting north from southern urban centres.

Due to the involvement of provincial jurisdictions, north-south connections within the provinces are easily administered. However, the following are the inherent disadvantages to such a pattern:

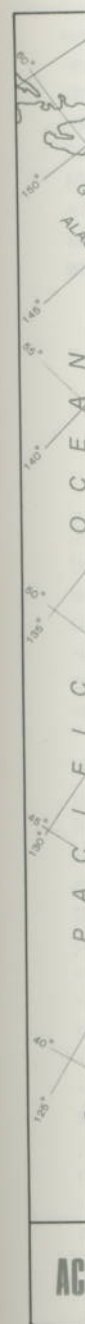
- (1) It promotes piecemeal development, and leaves many areas unserved;
- (2) The building of a railway on the basis of a single resource jeopardizes the economic viability of the line, as it is solely dependent on the stability of the demand for that one resource;
- (3) No routes are provided for the smaller resource deposits which, by themselves, may not justify a separate access. However, the cumulative effect of these deposits might exceed some of the larger individually-served developments;
- (4) The present system tends to encourage single function transportation and transient communities. At the same time, it makes the optimum development of resources difficult.

An east-west rail connection in Mid-Canada, linking the terminal points of the north-south lines (or their extensions) and terminating at northern harbors on Hudson Bay and the Pacific, Arctic and Atlantic Oceans, provides a system which, if added to the existing network, would form the basis for the development of Mid-Canada. Due to the development of new icebreaking techniques, submarine shipping and other new modes of transportation, the prospect of year-round operation of ports on the

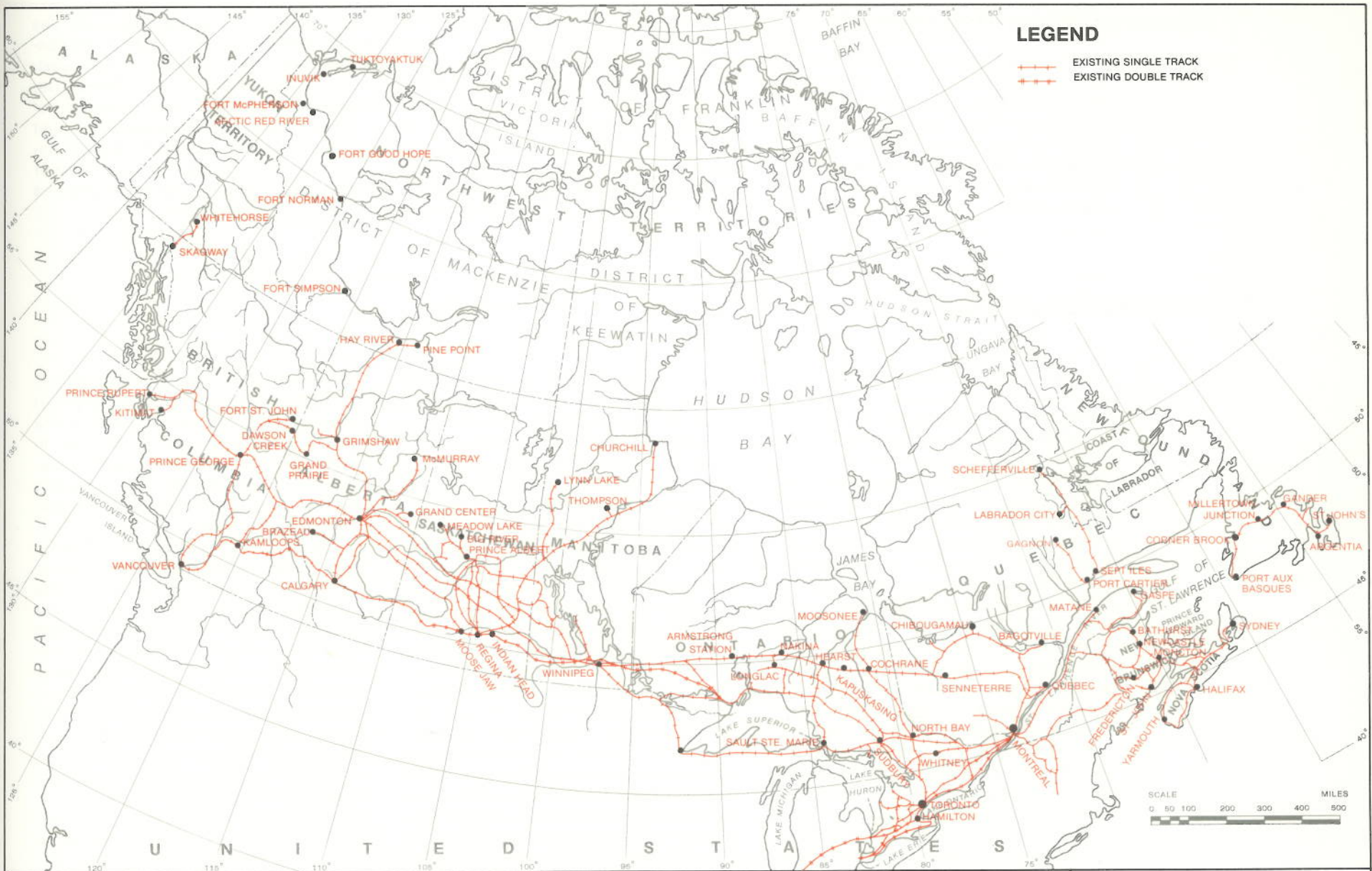
northern coastline now seems more realistic. A network of transportation could evolve, tying in major points in the south with resource locations in the north and with major ports on the northern coastline. Resources could then be shipped directly north or east-west to the ports. Apart from capital investment costs, the development would substantially reduce direct transportation cost — until now, the greatest single inhibiting factor in northern development.

In the long distance, bulk movement of minerals and forest products, the railways overshadow all other forms of transportation, both in weight and in volume. They are likely to continue to do so for a considerable time to come. Plate 17 shows most of the major railways in Canada, except for those in the most southern part of the country. A surprising number are of recent construction as shown by Appendix III. This appendix lists the railways built since 1950, and indicates the length, average cost per mile, and prime resources carried by each line. These railway lines are mainly north-south lines, based on the development of a single resource. Their combined mileage (approximately 2,413 miles) is almost equal to the distance between the east and west coasts.

Among the more important railway extensions is the Hudson Bay Railway, built in 1929, which runs 510 miles from The Pas to Churchill. Another line is the Quebec, North Shore and Labrador Railway, built in 1954, running from Sept Iles and terminating at Schefferville. The most recent extension is the 400-mile Great Slave Lake Railway, which was









constructed to serve Pine Point Mines in the Northwest Territories. It was built by the federal government at a cost of more than \$85 million. The government expects to recover about \$20 million from Pine Point Mines during the first 10 years of operation. The best part of the remaining \$65 million is considered an investment in a rail-water link to the Arctic Ocean, intended to encourage

further exploration and development of the Northwest Territories.

Appendix III also gives the average cost per mile of rail extensions built since 1950. These costs vary from \$104,000 to \$350,000 per mile, according to the nature of the terrain traversed and the years in which the railways were completed. The average costs, escalated to the present time, are used to estimate

the cost of potential new railways. The latter are indicated on Plate 21 as possible lines for achieving a new east-west connection in the Mid-Canada Development Corridor. The experience of railway companies indicates that freight and passenger rates could be comparable to those prevailing on the major east-west railways, provided economies of scale can be realized.

## 18—Transportation: Roads

Roads built in recent years have made Mid-Canada less remote. One of the major roads built in the last 25 years is the Alaska Highway, completed in 1942. It is 1,527 miles long, and cost more than \$100 million. This highway is of great economic importance to Alaska and adjacent northwestern Canada. Its construction initiated a tremendous road building program — in fact, between 1960 and 1975, as much as \$1 billion will be spent on roads. Another major road is the Mackenzie Highway from Grimshaw, Alberta, to Hay River and Yellowknife on Great Slave Lake, with an extension to Fort Smith. The recent establishment of a snow road from Fort Simpson to Inuvik, and the planned roads from Hay River to Tuktoyaktuk, and from Yellowknife to Coppermine, will aid development in these isolated areas.

Many roads used for exploration and supply purposes are part of the Roads to Resources Program, a national undertaking designed to provide access to areas potentially rich in natural resources. Under that program, the fed-

eral government has agreements with all 10 provinces regarding the construction of a total of nearly 5,000 miles of roads, estimated to cost nearly \$200 million. More than 3,000 miles have been completed to date, all under varying cost sharing arrangements between the federal and provincial governments and private enterprise. The Development Road Program in the Yukon Territory and the Mackenzie District is distinct from the Roads to Resources Program. The federal government is responsible for the total cost of construction, while maintenance costs for the northern roads are shared by the federal and territorial governments on an 85 percent-15 percent cost sharing basis. By 1965, about 1,300 miles of development roads were in use in the Yukon Territory. Construction costs totalled \$30 million. The combined figures for the Northwest Territories and Wood Buffalo National Park are: 750 miles of roads, costing approximately \$29 million.

In 1965, the Department of Northern Affairs and Natural Resources embarked on a 10-year road building program,

with annual expenditures of \$10 million. Its objective is to bring all potential areas of resource development in the Yukon and Northwest Territories to within 200 miles of the nearest permanent road. This will reduce the north's isolation, and its dependence on seasonal transportation.

Road building in north-central Canada is confined mainly to a paved road to Flin Flon, and gravel roads to Churchill Lake and to Southend. The most northern points served by roads in northwestern Ontario are Red Lake, Pickle Crow and Nakina. The railways from The Pas to Churchill, and from Cochrane to Moosonee are the only land-based connections to Hudson Bay. In Quebec, there are few inroads into the north, with the exception of the Chibougamau Road. Labrador City and Schefferville areas are presently served by rail only. However, recent planning in this region centres on the proposed Labrador Highway, designed to connect Labrador City with Churchill Falls, Goose Bay, and Forteau, on the Strait of Belle Isle. A tunnel under the Strait and a road-link to the New-







foundland section of the Trans-Canada Highway would complete a 2,000-mile route to St. John's, Newfoundland. Unofficial estimates for only the Labrador section (550 miles) are set at \$100 million.

No land-based route penetrates the mineral-rich Ungava District. Airlines, and coastal shipping for part of the year, are the only connections to this area.

The internal road systems of Mid-Canada are comparatively recent developments. The choice of one route over another is of great consequence. For example, the Yukon has approximately 2,000 miles of permanent internal roads,

while the Northwest Territories have only about 500 miles. The latter, however, is approximately six times greater in area. Perhaps the relatively early existence of the Alaska Highway accounts for this fact. The Labrador Highway or a railway could play an equally important role in the eastern section of Mid-Canada.

To complement the older east-west railway system, the Trans-Canada Highway provides a complete east-west road link. This is a joint federal-provincial undertaking, largely financed by federal funds. By March of 1966, about 4,200

miles of the contemplated 4,900 miles were completed, at a cost of \$948 million.

Existing transcontinental roads, railways, and airways have contributed immeasurably to the development of southern Canada, and the capital costs involved have come to be regarded as part of the general cost of nation-building. Although the optimum level of southern development in Canada has not yet been reached, the time is ripe to start the process in Mid-Canada. The returns of northern development may be even greater than the returns from the southern system's development.

## 19—Transportation: Air and Water

### Air Transport

Today, air travel in Canada is as important as any other mode of transportation. Not only is air service essential for high speed passenger and freight movement, but also it is vital to the many small outposts and settlements located in regions of Mid-Canada which are otherwise inaccessible for part of the year. The country is now served by five major Canadian air carriers, four domestic carriers, and a host of small private companies. There are two types of services — scheduled and non-scheduled. Scheduled services are provided by Air Canada and Canadian Pacific Airlines, serving the large centres of the Canadian south. The non-scheduled are provided by regular and irregular specific point air services, charter and contract services, as well as by flying clubs and special air services.

The non-scheduled services contribute most to Mid-Canada. Plate 19 shows the network of airways and airports in existence. Float-equipped planes are in wide use, and many air-

ports are merely terminal points and refuelling stations on the edges of some of the thousands of lakes scattered throughout Canada.

The Department of Transport is the only major operator of civil airports in the Yukon and Northwest Territories. In the early sixties, it spent between \$4 to \$5 million annually on the construction and operation of civil airports. The per capita air miles travelled in Mid-Canada are high, but airport revenues in the early sixties averaged less than 20 percent of operating and maintenance costs.

Due to vast distances and a scarcity of year-round surface transport, air cargo operations play an important role in Mid-Canada. This is true particularly in cases where speed is essential, and for the transport of low weight, high value goods such as precious metals. Air fares and freight rates in Mid-Canada are approximately 50 to 100 percent higher than those in southern Canada. Charter rates for larger aircraft vary less, and are closer to those in the south.

### Water Transport

Heavy reliance on water transportation exists in Mid-Canada, primarily in the Northwest Territories. There, the Mackenzie River system provides a navigable inland waterway of more than 1,000 miles, from Great Slave Lake to the Arctic coast. With the inclusion of one impassable section which must be portaged, the system extends another 600 miles south. The Mackenzie River is an important means of north-south transportation, but forms a formidable barrier to east-west connections. Until recently, land freight from Edmonton to Tuktoyaktuk moved by four stages — by rail to Waterways, by shallow draft river fleet to Fort Fitzgerald, by truck and tractor across a portage road, and by river fleet from Fort Smith to Tuktoyaktuk. Today, freight reaches Hay River via the Great Slave Lake Railway, is barged straight north, or else is flown in directly. Elsewhere in Mid-Canada, water transportation is important for exploration activities, and for the coastal movement of freight to remote settlements.









## 20—A Development Corridor

The development corridor indicated on Plate 20 is the logical outcome of a methodical approach to the concept of developing Mid-Canada on a planned basis.

The shape of the Development Corridor is the result of applying a "sieve" process, with all of the preceding plates superimposed on each other. In most instances, areas have been eliminated which, for any particular criteria such as climate, resources or transportation, are not optimum for development. By eliminating the negative development aspects, a corridor area emerges, within which most of the positive elements are present.

The residue of the sieve process produces in Mid-Canada a contiguous area:

- (1) generally supported by historic development, existing activities, and facilities in the adjacent southern developed regions;
- (2) in which the general topography, physiography and climate are acceptable, to the degree that development and settlement are possible;
- (3) in which many of the soils are of a workable nature, and suitable for

development;

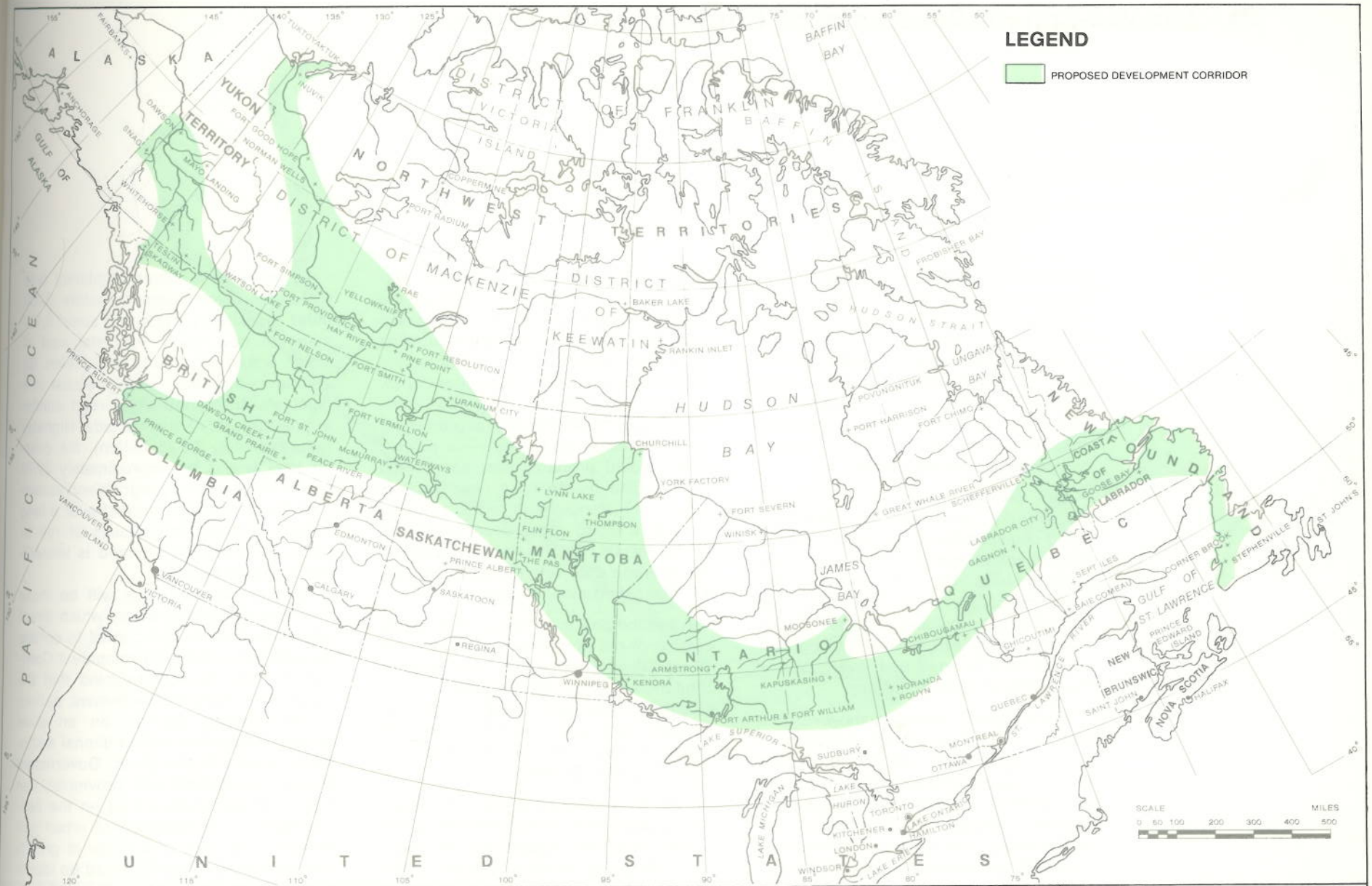
- (4) in which there is a high frequency of occurrence of large mineral deposits, extensive forest resources, some agricultural potential, sufficient and well-distributed water resources, adequate energy development possibilities, good tourist potential, and recreation opportunities;
- (5) with a high absorption capacity for large numbers of people, a high capability for intensive economic activity, and allowing a viable system of urban growth centres and settlements;
- (6) in which there is a distinct possibility of extending and integrating the existing single-function north-south rail lines into a viable multi-function east-west railroad network;
- (7) which will facilitate road development to complement a rail system, ensuring good intercommunications between settlements, as well as encouraging further exploration and exploitation;
- (8) which will utilize potential water transportation to a maximum, allow new port development on the north-

ern coastline, and enlarge existing ports on the Pacific and Atlantic Oceans and on Hudson Bay;

- (9) which will utilize and promote the further development and efficiency of the existing air transportation network;
- (10) which, through development, will realize the potential of Mid-Canada and the south and will, therefore, create a stronger, richer and more populous Canada.

The general shape of the Development Corridor is based on a synthesis of the preceding Plates and the accompanying text. It should be pointed out once more that the objective of this study is to deal with the concept of corridor development, and not with the exact delineation. The delineation as indicated on Plate 20 is not to be interpreted as definitive or final. Nor can it be claimed that the approach taken by this study is the only approach. It is, however, a positive, comprehensive approach designed to meet a need for national planning and development — a need which should no longer be treated in isolated sectors.







## 21—The Mid-Canada Development Corridor: Implementation

There are certain prerequisites to the implementation of the Mid-Canada Development Corridor concept. The most important is transportation. Plate 21 indicates the routes already existing in the Corridor which, with extensions and additions, could form a complete network. It would provide a new east-west link, and a more direct route to existing and potential transfer points.

The possible transportation routes in the Corridor, as indicated on Plate 21, could consist basically of rail or road, or a combination of both. However, since it is desirable to ship bulk goods with the least possible trans-shipment, the system should initially consist of a continuous railroad, with extensive inter-regional connections by road and, eventually, a new transcontinental highway.

The proposed routes, as shown on the map, are intended only as indicators of their possible alignment. Obviously, the type, alignment, and construction of a rail or highway route would be the result of feasibility studies. One of the objectives of this study is to indicate how much of the existing system could be utilized, and the possible cost implications of closing the gaps, to produce a continuous coast-to-coast system in the Mid-Canada Development Corridor.

The completion of a continuous railway system from Newfoundland to the Great Slave Lake region, and from there north to Tuktoyaktuk, utilizing 880 miles of existing tracks in the Corridor, would involve approximately 4,100 miles of new track at a cost of about \$1.0 to \$1.2 billion. This excludes the cost of a crossing at the Strait of Belle Isle — a project which would probably cost some \$150 million. The length of a new track is based on distance in air miles, adjusted by factors taking into account the nature of the terrain. The costs are based on the average cost referred to in Section 17, "Transportation: Railways".

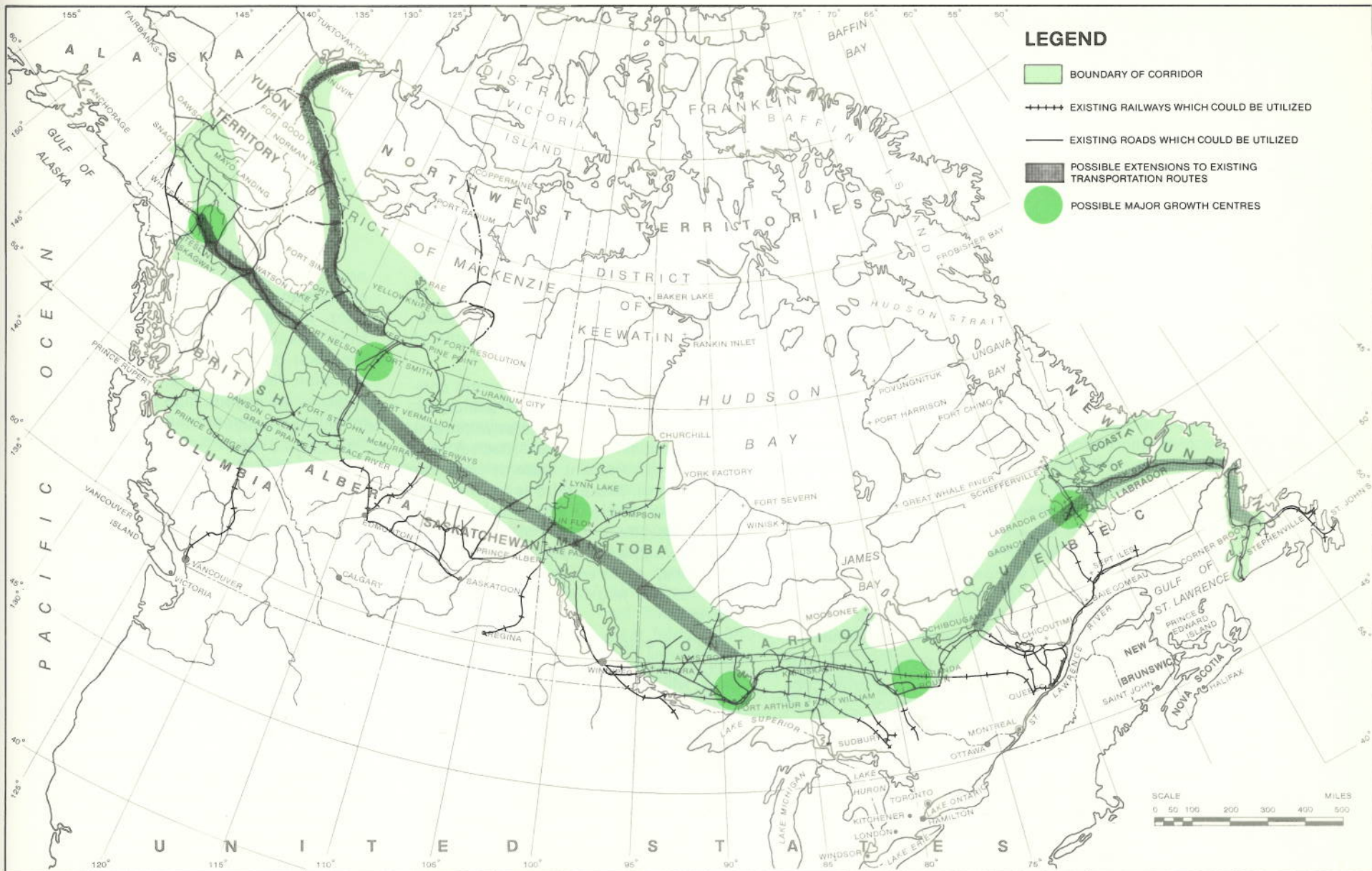
A second possibility projects the same section of rail from Newfoundland to the Great Slave Lake region, from there to Whitehorse, then via existing rail to Skagway. This system has 700 miles of existing track and would require 4,000 miles of new track, estimated to cost from \$1.0 to \$1.2 billion.

The third possibility also considers the section from Newfoundland to the Great Slave Lake region, but continues from there by existing rail to Prince Rupert. Involved are 1,800 miles of existing track and 2,950 miles of new track, at an estimated cost of approximately \$0.7 billion.

All three possibilities combined (see Plate 21) involve approximately 2,000 miles of existing track and some 5,100 miles of new track, the total cost of which would be around \$1.5 billion. By adding to this total figure the cost of a complete transcontinental road similar to the present Trans-Canada Highway (approximately \$1.25 billion), the overall total would be approximately \$2.75 billion. The building program and associated costs would be spread over a long period of time. The phases of rail or highway where the demand is immediate would be built first.

Of great consequence will be those elements of national policy which direct economic activity and capital to certain specific areas in the Development Corridor. It must be kept in mind that the naturally developing settlement pattern in Mid-Canada will be on an even broader scale than the traditional settlement pattern in the south. Government policy, both federal and provincial, can have a considerable effect on the centralization of population and urban settlement. Therefore, a number of growth centres and new towns should be identified as soon as possible. Plate 21 indicates the possible location of a number of these major growth centres. Their locations could conceivably centre







around Whitehorse, the Hay River district, the Thompson-Flin Flon-Lynn Lake area, the Lakehead, the Noranda district, and the Labrador City region. Although the actual designation of growth centres must be the result of detailed studies, the indicated locations could become important regional service centres, with major growth potential and with populations of up to half a million people.

The development of the growth centres is dependent on the degree of economic growth in the Development Corridor. The reciprocal stimuli from the centres is of equal consequence, as this would increase economic activity throughout the Development Corridor.

Vast capital and manpower investments are required in the growth centres, in terms of the provision of sound infrastructures, adequate transportation facilities, harbor and dock facilities, industrial park developments, location incentives, terminal facilities, new town development, etc. These investments could easily reach proportions of \$1.5 to \$2.0 billion, raising the total investment to a range of \$4 to \$5 billion.

It is obvious that the conscious creation and implementation of a Mid-Canada Development Corridor concept, as

outlined in this study, must be a national undertaking, requiring vast amounts of public and private capital and manpower, and the support of the people of Canada.

Several possibilities exist for the control and financing of parts of this development. One method is exclusive federal government financing and control. Another is government subsidy and related control, and a third is for the government to create a Crown corporation for the specific purpose of creating the railways, highways, new towns, and new industries, required for the establishment of the Mid-Canada Development Corridor.

Such a corporation could be authorized to issue public bonds and debentures, which could be guaranteed by the government and which would carry with them common shares as a bonus for Canadian investors. Common share holdings could be confined to Canadian citizens and to Canadian-owned and Canadian-controlled corporations. The latter method indicates development by subscription of public money which, if feasible, would probably be the preferred method.

The provision of adequate incentives to bring industry and people into the

area will play an important role in the establishment of the Development Corridor. Incentives for industry may vary from direct financial subsidies, to the provision of tax regulations or a transportation rate structure. Incentives for settlers may include high incomes, good employment opportunities, long holidays, and urban settlements of sufficient size and with a wide range of services and amenities, a climatically-controlled environment, and good, inexpensive transportation links to other settlements in Mid-Canada and in the south of the country.

The rate of development in Mid-Canada will, to a large extent, depend on the demand for its resources. Other factors, such as national, social and economic policies, can accelerate this development.

Creation of the Mid-Canada Development Corridor will depend upon the provision of adequate transportation facilities, diversity of development, sufficient incentives for the location of industry, good employment opportunities, and the amenities which are enjoyed in southern communities. Above all, the rate of development of Mid-Canada will greatly depend upon a national policy which expresses the kind of nation in which Canadians wish to live.



## Appendix I—Trends in Transportation

The implementation of the Mid-Canada Development Corridor will depend on the creation of an efficient transportation system for goods, materials, equipment, and people.

Technological improvement in the transportation industry is a continuing process. Future technical advance will involve the refinement of existing modes of transportation, including railways, roads, pipelines, water and air transport. Hovercraft, cargo submarines, and track vehicles will be made more effective, and these relatively new vehicles will be able to provide more efficient service than traditional transportation modes.

### **Rail Transportation**

In recent years, technological changes have improved the competitive position of the railways. Large-scale conversion to diesel power, the construction of computer-controlled marshalling yards, and the application of containerization, have resulted in increased operating efficiency. Now, the handling of cargo is sys-

tematized and automated. The construction of light-weight passenger and freight cars makes higher travelling speeds possible. In the future, driverless trains may operate by remote control over long distances. New types of equipment such as tri-level automobile carriers, super tank cars, and "hi-cube" 83-foot box cars are now in use. The co-ordination of rail-water-road service will become increasingly effective in the near future, with more efficient facilities and services, resulting in lower costs.

The ability to carry long-haul and bulk cargo is the important advantage of a railway. For loads of over one million tons, the railroad can provide the lowest cost per ton-mile of any mode of transportation. Maximum train capacity has increased from the 4,000 tons of a few years ago to 10,000 tons today, and is expected to increase to 30,000 tons in the future. As a result, the efficiency of long-haul bulk cargo movement will steadily improve. It may be noted that up to 100,000 tons of cargo will be carried in the future by using "slave" loco-

motives between every 100 cars.

Compared to other methods, the railway is the most immune to adverse weather conditions — a very important factor in the creation and viability of the Mid-Canada Development Corridor.

### **Road Transportation**

During the last 35 to 40 years, road transportation has emerged as an influential factor in the economy of Canada. Car and truck vehicles will also play an integral and indispensable part in the existence of any urban community in the Mid-Canada Development Corridor.

In most areas of Mid-Canada, road building costs range from \$35,000 to \$80,000 per mile for a minimum acceptable standard gravel road, 20 feet wide. This type of road could provide links from mining camps and small manufacturing communities to the major road network in Mid-Canada. As traffic volumes increase, roads could be upgraded to paved standards of Trans-Canada Highway quality, at a cost of approximately \$500,000 per mile, depending on



the terrain and availability of construction materials.

Convenience, speed, and low loading costs, are the principal advantages of trucking. Also, on short hauls, unit sizes can be matched to load sizes. Trucks will remain the dominant transportation mode for short hauls. For long hauls of 150 miles or more, trucks will remain competitive only if improvements can be made in engine efficiency and vehicle size. Diesel units and gas turbines are required in the trucking industry, if trucks are to compete with air freight and railways.

Piggyback and container operations, with the railways carrying trailers on freight trains at scheduled speeds of over 60 miles per hour, are removing the speed advantage of inter-city trucking. For small loadings of less than 250,000 tons per year, the operating costs of trucks are less than the track maintenance costs of railways. This advantage disappears with larger loadings. Also, adverse weather conditions can temporarily close down a trucking opera-

tion. However, the flexibility of roads is of sufficient importance that all major communities in Mid-Canada should eventually be connected by a road system, even though railway connections may exist.

#### **Air Transportation**

In order to reduce unit costs of transporting passengers and freight, today's aircraft are larger. Jumbo jets, with a capacity of approximately 400 people, will be in service by 1970. An aircraft with a 1,000-passenger capacity may be in operation by mid-1970. Vertical take-off and landing planes have been developed and are being improved. The use of this type of aircraft in Mid-Canada could eliminate the necessity for the construction of miles of runway, and would allow for greater flexibility in the location of terminal facilities. The resultant saving could reduce the cost of air travel, and would make air freight more competitive with other types of transportation. Improvements in navigational aids will permit aircraft to land in poor

visibility conditions. Short take-off and landing planes — such as the Beaver, Otter and Caribou — can land and take off on 1,000- to 2,000-foot runways, which may be paved, gravel, grass or water surfaces. Aircraft of this class have already played an important role in opening up new areas, and will continue to do so. The helicopter has become the workhorse of Mid-Canada, and its role will become increasingly important. Large helicopters, with pay loads of 15 tons and more may soon be in service.

#### **Pipelines**

For the transportation of fluids and some types of solids, in medium to large quantities of one million tons or more per year, pipelines are a cheap, controlled transportation system. Pipelines are unique in the sense that they are not affected by adverse weather conditions.

Construction costs for a 6-inch line, capable of carrying one million tons per year, are about \$21,000 per mile, increasing to \$40,000 per mile for a 10 mil-



lion ton per year pipeline. At present, pipelines carry special bulk materials in one direction only and, therefore, must be supplemented by other modes of transportation. In the future, pipelines will carry a greater variety of containerized materials which will be moved by fluids in the pipeline.

#### **Water Transportation**

Water transportation is the cheapest method of moving large quantities of goods over long distances. With the development of super tankers, ships will be able to carry up to one million tons. However, ships of that size will require deep harbors and deep water routes. The vessels may be useful in hauling ores and fuels from one coast of Canada to foreign markets, but difficulty will be encountered in the navigation of Canada's northern waters. However, in the future, new icebreaking techniques and new vessels will improve shipping possibilities in the Arctic Ocean. As a result, important ports may develop on the northern coast of Canada.

Containerized ships and unit loading with containers have been developed to reduce port time and cargo handling. Standard containers improve both ship turn-around time and loading costs. A standard container is easily carried on railway and road vehicles, providing flexible freight handling from shipper to receiver. Containers will also assist in co-ordinating shipping with other types of transportation to, from, and in the Mid-Canada Development Corridor.

#### **Hovercraft, Cargo Submarines and Track Vehicles**

The Hovercraft has unlimited potential for assisting in the development of Mid-Canada. This craft, first developed in England, can travel at relatively high speeds on land and water. Existing models of the Hovercraft have a range of approximately 350 miles, and can travel at speeds up to 70 miles per hour on water and land. As the vehicle has a relatively high operating cost (20 cents per ton-mile) and a short range, it may

be limited to carrying high value, light weight commodities. Larger models, with capacity for several hundred passengers and 30 automobiles, are now being constructed.

Cargo submarines will have a number of advantages for transporting bulk cargo in the coastal waters of Mid-Canada, if harbor facilities can be kept ice-free at the point where the submarines surface. These submarines can travel under the icecap at speeds as great, or greater, than those of surface ships. Due to the high cost of operating surface ships in the waters of northern Canada, submarines may prove to be an important economical long-haul transportation vehicle.

Track vehicles are designed to travel mainly on soft, marshy ground or snow. The speed of the vehicle is usually less than 10 miles per hour. Improvements will probably be made in the design of these vehicles, but it appears that the Hovercraft will be more advantageous for the particular requirements in Mid-Canada.



## Appendix II—Concepts of Northern Settlement

In the past, settlements in Mid-Canada were built on the basis of social and economic values and attitudes suitable in southern Canada, but irrational in Mid-Canada. Attempts to come to terms with the climatic and other inherent differences of Mid-Canada were rare. Many settlements, which were not expected to become very large, presently serve complex economic functions and have developed permanence. But, even of the major settlements, few have emerged with adequate population to support the range of social, educational and cultural facilities found in most southern centres. A limited economic life span gave rise to substandard physical development, and encouraged social attitudes normally found in nomadic societies. The net result was a progression from high cost pioneering to high cost and inefficient settlement, with consequent high costs for transportation, communications, and living. The climatic and other physical limitations

found in many parts of Mid-Canada are seldom so severe that they cannot be endured or overcome.

Paradoxically, when faced with the problem of carrying out the daily tasks of living in a hostile climatic environment, man has invariably constructed some type of "core" city. A core city may be defined as a high density, limited area, in which may be found a high concentration of different functional activities, including several or all of the following: residential, commercial, institutional, recreational, and transportation. Usually the core itself contains at least the basic components of transportation and commercial activity. The core unit could be a life-support system for a space voyage — or a primitive settlement designed to withstand intense heat in the desert of Yemen. It might be an ocean-going vessel, equipped to withstand all manner of climatic variations, and providing a high degree of comfort

and convenience for passengers and crew. Or it may be a communications station in the Arctic or Antarctic. All are essentially core cities — self-contained, and relatively self-sufficient, physical environments for men.

The example of at least two other highly industrialized nations, Sweden and the U.S.S.R., suggests that, if development in Mid-Canada is to be successful, its settlements must be developed on a much larger, comprehensive and integrated basis than has yet been considered.

In Sweden, in the vicinity of the iron mining centre of Kiruna, a number of core settlements demonstrate that, not only is the core city a possible method of coping with the severity of a sub-Arctic climate, but also that the approach is essential in effectuating physical development objectives in an economic and rational manner. In Lulea, the port outlet for the mining centre of

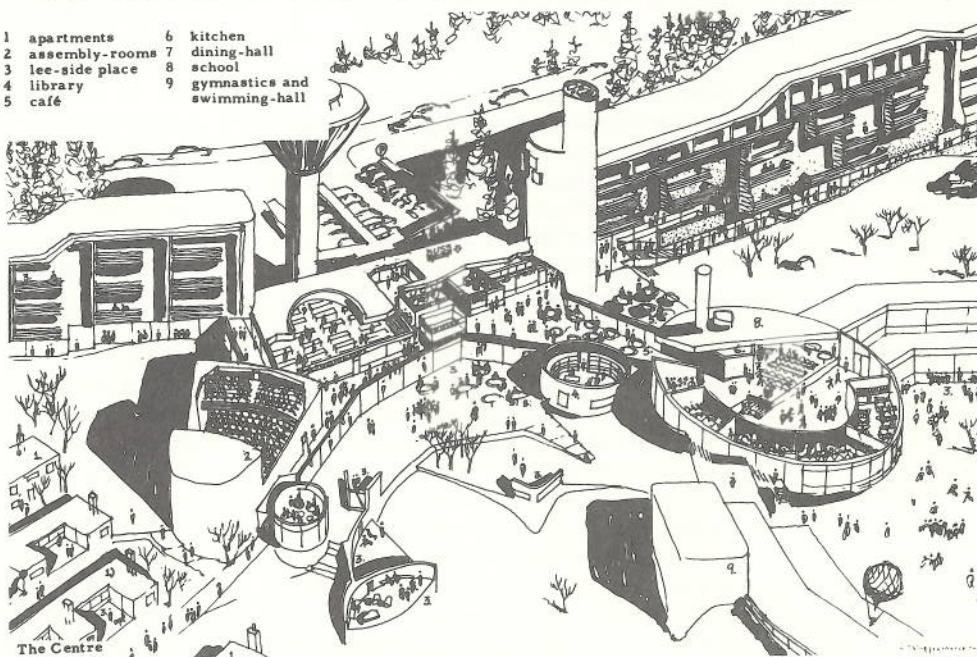




Kiruna, a shopping complex expresses the basic principles of developing an effective town centre in the north. It comprises an all-weather multilevel complex of theatres, shops, offices, parking and transportation.

In Svappavaara, an iron ore mining site not far from Kiruna, a competition was held for a development plan for the town. The winning solution, a plan by the architect Ralph Erskine, resembles a butterfly, with the main urban centre in the thorax and residential areas in the wings. The structure is designed for growth, and is oriented for optimum micro-climatic conditions, providing for reflection of the limited winter sun, shade from the midnight sun, and protection from winds. This centre features continuous weather-protected galleries and pedestrian walkways, and includes commercial, recreational, and cultural activities, and provision for light industry.

- |                  |                  |
|------------------|------------------|
| 1 apartments     | 6 kitchen        |
| 2 assembly-rooms | 7 dining-hall    |
| 3 lee-side place | 8 school         |
| 4 library        | 9 gymnastics and |
| 5 café           | swimming-hall    |



Svappavaara new town — Competition design/Ralph Erskine, Architect  
 Source: *Swedish Planning of Town Centres*, the Swedish Institute, Stockholm 3, Sweden