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**Delineation of Canada's North:
An Examination of the
North–South Relationship in Canada**

by

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ABSTRACT

Statistics Canada's interest in a common delineation of the north for statistical analysis purposes evolved from research to devise a classification to further differentiate the largely rural and remote areas that make up 96% of Canada's land area. That research led to the establishment of the census metropolitan area and census agglomeration influenced zone (MIZ) concept. When applied to census subdivisions, the MIZ categories did not work as well in northern areas as in the south. Therefore, the Geography Division set out to determine a north–south divide that would differentiate the north from the south independent of any standard geographic area boundaries.

This working paper describes the methodology used to define a continuous line across Canada to separate the north from the south, as well as lines marking transition zones on both sides of the north–south line. It also describes the indicators selected to derive the north–south line and makes comparisons to alternative definitions of the north. The resulting classification of the north complements the MIZ classification. Together, census metropolitan areas, census agglomerations, MIZ and the North form a new Statistical Area Classification (SAC) for Canada.

Two related Geography Working Papers (Catalogue No. 92F0138) provide further details about the MIZ classification. Working Paper No. 2000-1 briefly describes MIZ and includes tables of selected socio-economic characteristics from the 1991 Census tabulated by the MIZ categories, and Working Paper No. 2000-2 describes the methodology used to define the MIZ classification.

1. INTRODUCTION

The 'North' is a significant part of the Canadian identity and an important component of our history, our geography and our future. The north is rich with natural resources, possessing immense potential and posing immense challenges. The term, north, invokes many different interpretations or perceptions. We all profess to know where the north is, but do we know where it begins or ends? Where do we put the line between north and south Canada? And most importantly, what are the differences in people's characteristics and associated needs based on their location in the north or the south? Statistics Canada took on the challenge of developing a separate standard delineation of the north for statistical purposes, as an extension of research into an improved delineation of the rural and small town areas of Canada.¹

1.1 Why Delineate the North?

Researchers have followed different paths and reached diverse conclusions on what constitutes the north. Some consider the north as the almost one-quarter of Canada that is the Arctic or extreme north. Bone (1992) defined the north by two natural regions: the arctic and the sub-arctic. The boundary between the north and the south follows the southern limit of the boreal forest. However, the use of environmental zones has a drawback since most statistical information is classified by administrative units and is not readily available by natural regions.

Other researchers think of the north as the far north, or north of 60°N, referring to the Yukon, Northwest Territories and Nunavut. By choosing a convenient political boundary, this definition ignores similarities in climatic and physical attributes, economic structure and population settlement patterns between the territories and the northern parts of Labrador, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. Many essential dimensions of what constitutes the north are not captured. Still other definitions might include the northern parts of these provinces.

Statistics Canada's interest in a common delineation of the north for statistical analysis purposes evolved from research to devise a classification to further differentiate the vast non-metropolitan areas that cover 96% of Canada's land area. That research led to the establishment of the census metropolitan area and census agglomeration influenced zone (MIZ) concept. MIZ uses commuting flows to determine the degree to which census metropolitan areas (CMAs) and census agglomerations (CAs) influence census subdivisions outside of CMA/CA limits. The MIZ categories of "strong", "moderate", "weak" and "no" influence did not appear to apply as well in northern areas as in the south.² Therefore, a decision was made to separate census subdivisions (CSDs) in the north from those in the south. Geography set out to determine a north-south divide that would differentiate the north from the south.

2. METHODOLOGY FOR DELINEATING THE NORTH

Initially, the Geography Division delineated the north using four indicators—geographic location, southern limit of the boreal forest, heating degree-days and accessibility—applied to census subdivisions

¹ In 1990, the Organization for Economic Co-operation and Development (OECD) established a rural development program. One aspect of this program was a rural indicators project, designed to improve the understanding of rural conditions by collecting internationally comparable data (OECD, 1994). As part of Canada's contribution to this initiative, the Research Subcommittee of the Interdepartmental Committee on Rural and Remote Canada (on which Statistics Canada has representation) produced a further breakdown to the rural definition at the census division (CD) or "county" level for Canada (ICRRC, 1995).

Statistics Canada and the Geography Division recognised the benefit of differentiating non-metropolitan Canada at the census subdivision or "municipal" level, rather than the CD level, and developed the metropolitan influence zone (MIZ) concept using a methodology similar to that used to delineate census metropolitan areas and census agglomerations. The first studies done using these metropolitan influence zones showed their potential to demonstrate the diversity of rural and small town Canada (Howatson-Leo and Earl, 1995). Feedback on that early work recommended refinements to the MIZ classification and strongly supported the creation of a separate north category.

² For more details about the MIZ concept, methodology and applications, refer to the Geography Working Papers by Rambeau and Todd (2000) and McNiven, Puderer and Janes (2000).

(municipalities). Each census subdivision (CSD) was assessed against these indicators to determine whether it was in the north or south. The CSDs in the north included:

- (a) all CSDs in the territories,
- (b) each CSD in the ten provinces for which the total population was less than 100,000, within a radius of 75 kilometres from the CSD's population weighted representative point, and
- (c) each CSD in the ten provinces in which 50% or more of its land area falls *north* of both the southern limit of the boreal forest and the normal annual 6,000 heating degree-day line (where normal = the average for 30 years).

While this research proved the north concept, it was evident that both the census subdivision shape and size significantly affected the resulting definition of the north. It was concluded that a polygon-independent approach would be better.

The second methodology defined a line that separated north and south independent of existing statistical units. This method recognised the numerous diverse definitions of the north and attempted to build on those concepts. In the end, the north–south line was defined as the average of 16 factors or indicators. Then transition zones based on one standard deviation from the mean were added on both sides of the north–south line. As a result, any geographic unit can be classed as north or south, or can be assigned to one of the four zones based on the location of its population centroid or geographic centroid relative to the dividing line.

The method used to define a north–south line along with transition zones was simple in concept. In practice however, the application and implementation of this methodology was somewhat more complex. The steps taken are described in more detail below.

1. Select representative indicators

A wealth of geographic information is available that potentially delineates regions of the country according to various climatic, biotic and socio-economic aspects. The initial list of north–south defining indicators numbered approximately 50. These indicators were examined and selected for inclusion if they met certain criteria. First, the indicator had to be represented by a line defined on a national, continuous basis that could then be displayed and analyzed. Second, the provenance of the line had to be verified from a secondary source or include documentation on supporting research/conceptual rationale.

From the start, the intent was to obtain authoritative digital lines. In cases where a digital line did not exist (or could not be obtained given budget and time constraints), a paper representation of the line was accepted and then digitized. The digitizing was constrained by both time and cost limitations. On the basis of the above selection criteria and given the operational constraints, 16 lines were selected. The lines selected are described in more detail in the next section and are depicted on Map 1 in Appendix 1.

2. Calculate average and standard deviation

Once the 16 lines were in digital form, the point(s) of intersection of each line with meridians of longitude (183 meridians at half degree intervals between 51° and 142° west) were determined. (In some instances, the lines looped back and forth, intersecting a meridian more than once. This was especially the case in western Alberta and British Columbia given the influence of the mountains.) All points of intersection were used to calculate the mean point along each meridian of longitude. Then the points representing one standard deviation north and south from the mean were calculated on each meridian of longitude. Finally, the mean and the north and south standard deviation points of intersection on the meridians of longitude were connected to create the north–south demarcation line and the north and south transition lines³ (see Appendix 1, Map 2).

3. Smooth the lines

The resulting fluctuations in the three lines suggested an element of precision and certainty that could not be supported due to a variety of data quality factors (measurement error, interpolation error, digitizing error, etc.). Some form of line smoothing was required. Smoothing was done by calculating a moving average using three, five and seven meridians. There was very little difference among the three lines using a three, five and seven point moving average, but from an aesthetic sense, the five point performed best. Thus, the final **north–south line** and the **north and south transition zone lines** are smoothed lines based on a five point moving average (see Appendix 1, Map 3).

3. NORTH–SOUTH INDICATORS USED AND THEIR LIMITATIONS

A variety of interactive dimensions exist that are unique to the north. These range from physical features to environmental factors to economic activity to population settlement and interaction. The physical and environmental attributes of the north do not absolutely control economic and human behaviour, but do constrain and/or modify them. The north is characterised in part by its cold climate, and in turn, activities are dictated to a large degree by the climate. Temperature enables activity and curtails activity and it is a clear measure of the potential of an area. Not solely a reflection of latitude, temperature reflects topography, hydrological features, prevailing winds and pack ice. Cold temperatures inhibit soil development, which impacts on agricultural activity, which in turn is dependent upon current climate, which affects settlement patterns, which impacts on economic activity. Given these complexities, as a guiding design principle, a new delineation of the north should reflect as many of the current north concepts and variations as possible.

The north–south indicators represent a complex set of environmental, political, biotic and human factors. While no single indicator or method is sufficient on its own to define the north, in aggregate the indicators can form a functional definition of Canada's north. A close, interactive relationship in the indicators is almost inevitable. For example, is it possible to truly separate agriculture data from climatic data? The interaction and inter-dependence between the indicators highlight the overlap and interaction between climate, the biosphere and human activity. This section identifies and discusses the background and limitations of the

³ Three alternative methods to the arithmetic mean were tried and evaluated.

- (a) Calculate a trimmed mean. The trimmed mean is the mean, but with the highest and lowest 10% of the values removed from the calculation.
- (b) Use the median instead of the mean. The 25th and 75th quartiles were used as the standard deviation equivalent.
- (c) Calculate a combined value by averaging the mean, the trimmed mean and the median along with their respective standard deviations.

The trimmed mean, (a), and, as a result, the combination approach, (c), produced a much smoother north–south line than that produced by the arithmetic mean approach. This was seen as an advantage but these approaches also reduced the absolute size of the standard deviation. In other words, the transition zones were narrowed suggesting more certainty than the data would otherwise support. Without conceptual justification supporting this outcome, these two approaches were rejected.

The median approach, (b), generated the most variable north–south line with a pronounced saw tooth pattern especially in the region from western Alberta to the western edge of British Columbia. This is a region where the input lines often looped back, crossing a given meridian more than once. Under these conditions, the median approach resulted in sudden position changes between adjacent meridians. Therefore, the median approach was dropped.

16 north–south indicators chosen for this phase of the research. The lines selected are depicted on Map 1 in Appendix 1.

1. Boreal Forest

The southern limit of the boreal forest is frequently used as an approximation of the south/north division in Canada (Bone, 1992). North of the tree line, several types of tundra and polar desert dominate Canada. To the south, as the soil and climate become more hospitable to vegetation growth, shrubs and small scrub trees appear in a transition zone. This transition zone traverses the tree line and gradually becomes the boreal (boreal means northern) forest of spruce, pine, and other various conifers. The boreal forest is “the vast tracts of trees that stretch in a broad unbroken belt between the far northern barrens and the settled southern edge” (Lanken, 1996, p. 26). The importance of the boreal forest goes beyond the biophysical characteristics of the land—it has shaped “our history...and economy” (Lanken, 1996, p. 27). Arguably, it is the single best indicator of the north-south divide.

The **southern limit of the boreal forest** was used for the initial delineation of the north and the same line was used again as one of the 16 indicators. The original map showing the southern limit of the boreal forest was produced as a joint venture between Canadian Geographic Enterprises, the Canadian Forest Service and Geomatics Canada of Natural Resources Canada and was published in *Canadian Geographic* (Lanken, 1996).

2. Heating Degree-Days

Given Canada’s climate, people need indoor heating for at least part of each year in order to live comfortably or even to survive. The term, heating degree-days, refers to the relationship between the outside temperature and the optimum inside temperature and is often used with reference to fuel or energy consumption for home heating.

To maintain an optimum inside temperature of 21°C, fuel or energy consumption over a specified period of time will vary in proportion to the difference between 18°C and the outside temperature for the same duration. (*National Atlas of Canada*, MCR 4033.)

Each degree Celsius below 18°C is considered one degree-day. Based on climate norms, the heating degree-day map (MCR 4033), produced by the *National Atlas of Canada*, displays the annual sum of the difference between the mean daily temperature and 18°C for each day the mean daily temperature is less than 18°C.

The number of heating degree-days ranges from under 3,000 for the warmest regions of Canada to over 13,000 in the far northern parts of Canada (north of 75°N latitude). The **6,000 degree-day line** was selected as the north–south indicator line. Areas north of this line require at least twice as much energy consumption to maintain the optimum inside temperature compared to the warmest regions in Canada. As well, the 6,000 degree-day line visually compared favourably with other lines, especially the Boreal forest line. (The 6,000 heating degree-day line was used as a climatic indicator for the initial delineation of the north, and the same line was selected as one of the 16 indicators for the new methodology.)

3. Growing Degree-Days

Climate also has an effect on the degree of plant growth that occurs in a region. The term, growing degree-days, refers to the relationship between the mean daily temperature and the temperature conditions suitable for plant growth. The higher the number of growing degree-days, the more heat available for plant growth. Although this relationship will differ for various plant species, a base value of five degrees Celsius has been defined as a suitable temperature threshold for plant growth to occur. Each degree Celsius above five degrees Celsius is considered one growing degree-day. For example, if the high temperature is 25°C for the day, the growing degree-days are 20.

Based on climate norms, the growing degree-day map (MCR 4034) produced by the *National Atlas of Canada* displays the annual sum of the difference between the mean daily temperature and five degrees Celsius for each day that the mean daily temperature is greater than five degrees Celsius. The values on that map, displayed at intervals of 250, range from over 2,500 (around Windsor, Ontario) to less than 250 (most land north of the Arctic Circle). The agriculture ecumene was used to determine a suitable cut-off point to separate north from south. The northern-most area of the agriculture ecumene is the Peace River region of Alberta with 1,200 growing degree-days a year (Statistics Canada). The accepted threshold for germination and growth of commercial agricultural crops such as corn and wheat is 1,200 growing degree-days. Therefore

the **1,250 growing degree-days** line from the MCR 4034 map sheet was selected as a delineating line and digitized (the 1,250 interval was the closest available interval to 1,200).

4. Discontinuous Permafrost

Climate conditions can also have adverse effects on the ability to physically work with the land. Once ground freezing occurs, there are serious limitations to land development and use. Permafrost is considered a major inhibitor of land use, restricting road building, construction, resource extraction and plant growth. Disruption of permafrost can cause major environmental damage (Bradshaw & Weaver). Permafrost occurs on a continuous basis in areas with an average annual temperature of minus seven degrees Celsius or lower, and discontinuous permafrost occurs in areas with an annual mean soil temperature range of two and eight degrees Celsius (Bird, 1972). The *National Atlas of Canada* displays the zones of continuous and discontinuous permafrost. The **southern limit of the zone of discontinuous permafrost** was chosen as a north–south indicator because north of this point, land use is impeded. The source of the line representing the southern limit of the discontinuous permafrost was the *National Atlas of Canada* (MCR 4177).

5. Agroclimatic Resource Index

The Canadian Agroclimatic Resource Index provides an approximate method for quantitatively comparing quality of the climate for agriculture in different parts of Canada (Williams, 1975). The index is calculated by considering growing season length, temperature and moisture as they relate to forage yields. The index is based on long-term records of hay yields, since hay is the only crop that is grown across Canada and can potentially use the full growing season. Specifically, the index is based on a growing season that is defined as the period in days between the last killing spring frost and the first killing autumn frost, with downward adjustments for inadequate summer heat in Maritime climates, and for aridity in the prairie region (Dumanski and Stewart, 1981). Index values range from 3.0 for Kent–Essex counties in south-western Ontario to 1.0 for the limit of the “agricultural frontier” (National Atlas, Williams). An **index of >1.0** was selected as the threshold representing the limit of the agricultural frontier. The line was digitized from the *National Atlas of Canada*.

6. Thornthwaite Summer Concentration of Thermal Efficiency

The 24-hour days in summer and 24-hour nights in winter are often thought of as significant characteristics of the North, but this is a strictly latitude-based measure that ignores climatic or topographical components. Climatic classifications make it possible to relate climatic type to other aspects of the natural environment. C.W. Thornthwaite’s third climate classification system (1955) included an Index of Average Annual Thermal Efficiency derived from potential evapotranspiration values. A significant component of Thornthwaite’s classification was the Summer Concentration of Thermal Efficiency that measures the concentration of thermal efficiency accumulating in the three summer months as a percentage of the average annual potential thermal efficiency. The Thornthwaite index was chosen as a proxy to represent day length while at the same time considering topography and maritime influences. Other measures similar to the Thornthwaite measure, for example the Koppen Climate Index (Bradshaw & Weaver), are available and could be substituted.

The *National Atlas of Canada* (MCR 4155) depicts the Thornthwaite classification applied to Canada based on observations at 1,250 climate stations. The Summer Concentration of Thermal Efficiency values range from less than 48.0% in the south to more than 88.0% in the north. The line depicting a **summer concentration of thermal efficiency value equal to 68.0%** was selected to represent the division between north and south. The location of the 68% line approximately corresponds to the southern limit of the boreal forest.

7. Population Ecumene

The term ecumene is one often used by geographers to describe inhabited land. There can be various types of ecumenes, but ecumene “generally refers to land where people have made their permanent home, and to all work areas that are considered occupied and used for agricultural or any other economic purposes” (1996 *Census Dictionary*, p.206). Most people will settle where they can maximize the economic, social, cultural, climatic and recreational amenities of a place. Northern Canada can be characterized as an area that has remained relatively uninhabited when compared to the more southern regions of Canada. In part due to the severity of climate conditions and the absence of fertile agricultural lands, settlement in the north has not taken place on a large scale. By mapping the areas that are largely populated, north–south delineation can be determined based on inhabited land.

The 1996 population ecumene, developed by the Geography Division, Statistics Canada, encompasses all enumeration areas with a minimum population density of 0.4 persons per square kilometre. Although there are population ecumene pockets in the territories and northern regions of the provinces, the delineation of the **major, more or less continuous portion of the population ecumene** located in the southern regions of Canada was used. Statistics Canada, Geography Division was the source for the data and line.

8. Agriculture Ecumene

The agricultural ecumene demonstrates the concentration of agricultural land use throughout the country. It does not, however, reflect the best or most efficient use of agricultural land, since most farmers will use adjacent land rather than move to the frontiers of the farm ecumene (Werschler, 1994). The agricultural ecumene, developed at Statistics Canada, delineates the agricultural land base in Canada at the enumeration area level based on data obtained through the 1991 Census of Agriculture. It is based on agriculture indicators such as the ratio of agricultural land on census farms relative to total land area, and total economic value of agricultural production. Regional variations are also taken into account.

Since Canada's settlement pattern has remained closely related to the **agricultural ecumene**, both ecumenes provide useful guidelines to establish a north–south delineation in Canada. By using these two ecumene patterns to indicate those areas within Canada that are inhabited, the remaining area characterized by uninhabited lands becomes a delineating factor for Canada's north. Statistics Canada, Agriculture Division was the source of data and the line.

9. and 10. All Season Road and Railway Transportation Networks

When communities are remote, road and rail access increase the opportunity for communities to interact with each other. This interaction allows these communities to maintain, to a certain degree, an economic advantage over those communities with no road or rail access. In addition, it can also be assumed that these communities will experience a lesser sense of remoteness. Thus, the lack of access to land-based transportation networks tends to reflect at least two of the characteristics associated with northern Canada—economic disadvantage and remoteness. By delineating the **northern limits of the all season road and rail transportation networks** within Canada as two indicators, the truly remote or northern regions of Canada are exposed. A variety of provincial and territorial roadmaps, representing different commercial and provincial sources were used; however, the primary source of data was the National Atlas Information Service (road – MCR 4050 and railway – MCR 4070). A 50-kilometre buffer was created around the all season roads and railway lines. The northern limits of the buffers were digitized to create two lines.

11. Accessibility Index

The concept of accessibility is based on the assumption that there are certain economic and social benefits associated with being in relative proximity to a minimum population concentration (e.g., availability of markets, skilled labour force, specialised health care and education services, etc.). An accessibility index, constructed by Armstrong (1993) using 1986 Census data at the census subdivision level, measured the average distance a person would have to travel to get to a threshold population of 100,000 people, the minimum population base required for a regional economy. This resulted in an index value that was always quite large for the territories and northern provinces, and quite small (approaching zero) for metropolitan areas.

Geography Division had derived a CSD-based population accessibility measure (described in section 2) for the initial north delineation. The approach was refined to create a more precise index that was based on enumeration areas (EAs) rather than CSDs. EAs having access to 100,000 or more people within a 75 kilometre radius were considered south. All other EAs were considered north. A continuous line separating north and south EAs was identified and digitized. This line representing accessibility was used as one of the north–south 16 indicators. A disadvantage of this accessibility index is that it is based on straight-line distance and does not account for actual travel time.

12. Living Cost Differential

Just as accessibility *decreases* the farther north you go, the cost of goods and services *increases* the farther north you go, so a measure of prices based on accessibility was sought. The federal government uses a living cost differential index for isolated posts where high prices prevail for food, transportation and household operation. This index could be used as another means of delineating the north.

When the living cost index exceeds 115 in relation to a base of 100 (the maximum is 190), relief is provided on a scale to federal government employees (for a full discussion see *Isolated Posts Directive, 1991*). Plots of the latitude and longitude of these isolated posts, along with their associated pay adjustment highlighted a clear trend, which delineated northern and southern Canada. **Posts with an index 115 and over** were plotted and the southern limit was outlined and used as an additional line.

13. Resourced Areas and Native North

Hawkins (1995) defined different categories of rural in Canada based on socio-economic data by census division (CD). Demographic, labour market, income, human capital and infrastructure characteristics were chosen for that analysis. A number of categories were described, including Primary Settlements, Urban Frontier, Rural Enclave, Rural Nirvana, Agro-Rural, Resourced Areas and Native North. The classifications of Resourced Areas and Native North are of importance to this research. In Hawkins' paper, Resourced Areas refers to "CDs dominated by the presence of mining and oil. There are young family structures, good and stable income and a high percentage of the population with post-secondary education" (p. 55). Native North refers to "CDs dominated by a very young population structure with population either centred in settlements or in remote areas. These CDs also have mining resources, but this employment is generally second to government services. There are few people with post-secondary education, low to moderate but apparently rising incomes" (p. 55). The **southern limit of the CDs defined by these two classifications** was digitized and this line used as another north-south threshold.

14. OECD Rural North

In 1990, the Organization for Economic Co-operation and Development (OECD) established a Rural Development Program. A research sub-committee of the Interdepartmental Committee on Rural and Remote Canada (ICRRC) took OECD's classification of regions and applied it to the Canadian context with some modifications (see ICRRC, 1995, *Rural Canada: A Profile*). Census divisions from the 1986 Census were classified into one of five types of regions—Agglomerated, Intermediate, Rural (metro adjacent), Rural (non-metro adjacent) and Rural North. The **southern limit of those census divisions that were categorized as Rural North** by ICRRC was digitized and used as another line delineating the north.

With respect to indicators 13 and 14 described above, the classification and mapping of a typology for rural Canada according to census data is not a simple task and presents some limitations. One of the main disadvantages of this type of analysis is the way in which the geographic areas are defined. Census divisions provide a generalized view of census data and lack considerable detail when compared to smaller geographic areas such as census subdivisions or enumeration areas. Census divisions are political boundaries of counties in some provinces (e.g., Ontario, Nova Scotia) and are boundaries solely established for statistical purposes in other provinces (e.g., Manitoba, Saskatchewan). Census divisions are high levels of aggregation that hide considerable local diversity. Nevertheless, results from the two above-mentioned studies of Canada provide important insights into the diversity of rural Canada and the definition of the rural north.

15 and 16. Revenue Canada Northern and Intermediate Income Tax Zones

In 1988, the Minister of Finance established a task force to examine the eligibility of northern and isolated communities for tax benefits. The task force studied the regional differences between the north and south in order to determine the various indicators of hardship and isolation in northern lands that contribute to high costs of living, lack of services and personal discomfort. The study concluded that four criteria, including population, distance to an urban centre, climate, and vegetation, are important indicators of isolation and hardship. However, it also determined that the indicating factors varied in terms of their importance. Consequently, each factor was given a weighted value according to the degree of isolation or hardship that it was thought to cause. The resulting classification defined a single Northern Zone (Zone A) delineated by lines of latitude and longitude and encompassing all of the Yukon, Northwest Territories and Labrador as well as the northern parts of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec. The Department of Finance added a further Intermediate Zone (Zone B) to bridge the gap between the Northern Zone and less isolated areas of the country. The limits of Zone B also follow lines of latitude and longitude and include parts of British Columbia (including all of Queen Charlotte Islands), Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Sable Island in Nova Scotia. The full definitions and methodology are described in *Report of the Task Force on Tax Benefits for Northern and Isolated Areas* (Ministry of Finance, 1989). The **southern limits of the Northern Zone and Intermediate Zone** were each used as indicators.

4. EVALUATION OF THE INDICATORS USED

Were the 16 indicators chosen the right ones? Would the results have been any different if other factors had been included? At one point during the research, lines representing 25 indicators had been digitized, but 9 of these were discarded because their provenance could not be verified from a secondary source, as was the case for all 16 final indicators. As the set of 25 was culled to the final 16, the impact of removing each line was assessed. The fact that nine lines were removed without discernibly altering the overall outcome supports the final 16 variable selection. Had time and resources permitted, lines would have been created for all of the alternative demarcations cited in the literature. However, it seems reasonably certain that the results would not have been significantly different from the results obtained using these 16 indicators since a number of them are really indexes. In fact, to significantly change the results obtained, it would be necessary to discard all the 16 variables and select an entire new set of variables that were radically different—an action that would not be justified based on the history of research in this area. Alternatively, a number of new variables clustered either north or south of the existing mean would need to be added or significant weights given to some of the existing 16 variables in order to change the outcome. Again, the justification for such an action would be questionable.

The Task Force on Tax Benefits for Northern and Isolated Areas compared the factors that they had selected to define the north with factors selected by two other respected studies on nordicity (Burns et al., 1975 and Hamelin, 1975). The comparison of factors was summarised in a table in Appendix IV of the Task Force's report (Ministry of Finance, 1989). Table 1 below includes information from the Task Force's report as well as the 16 north-south indicators selected by Statistics Canada. This table shows that the choices made by all the studies are similar, although the actual definition of the indicators may differ from one study to the other.

Table 1. Comparison of “North” Factors or Indicators

Factors	Burns et al	Hamelin	Task Force	STC
Latitude	x	x	x	
Precipitation	x	x		
Climatic Severity			x	
Summer Heat Above 5.6°C		x		
Growing Degree-Days	x		x	x
Annual Cold Below 0°C		x		
Heating Degree-Days	x		x	x
Freezing Degree-Days	x			
Length of Snow Cover Season	x			
Length of Ice Season	x			
Types of Ice		x		
Permafrost			x	x
Thornthwaite Index				x
Natural Vegetation Cover		x	x	x
Agroclimatic Resource Index				x
Agriculture Ecumene				x
Road Accessibility	x	x		x
Rail Accessibility	x	x		x
Road Accessibility / Distance to Urban Centre			x	x
Air Accessibility	x	x		
Population / Density	x	x	x	x
Degree of Economic Activity		x		
Price Index				x
OECD Rural North				x
Resource Area and Native North				x
Revenue Canada Northern Zone Boundary			x	x
Revenue Canada Transition Zone Boundary			x	x

In fact, the Northern Zone boundary defined by the Task Force on Tax Benefits for Northern and Isolated Areas is very similar to the north transition limit boundary derived by the Statistics Canada method.

5. APPLICATION OF THE NORTH CONCEPT

The research on the north concept was specifically initiated to complement the MIZ classification.⁴ The intent is to combine the CMA/CA, MIZ and north concepts into one statistical area classification (SAC) for dissemination purposes (Rambeau and Todd, 2000).⁵ The north classification (north, north transition, south transition and south) can also be used independently for analytical purposes (McNiven, 1999).⁶ It could also be combined as a cross-classification with the CMA/CA and MIZ categories (see Table 2) or any other geographic classification (e.g., urban – rural).

Table 2. Population of Canada showing North–South Location by CMA/CA and MIZ Categories, 1996 Census

	South	South Transition	North Transition	North	Canada Total
CMA	16,596,858	1,267,788	0	0	17,864,646
CA	3,708,569	750,429	83,960	42,251	4,585,209
Strong MIZ	1,390,895	152,283	21,522	137	1,564,837
Moderate MIZ	1,986,145	359,957	17,164	2,105	2,365,371
Weak MIZ	1,290,516	572,629	172,436	83,756	2,119,337
No MIZ	170,397	89,678	51,087	36,199	347,361
Canada Total Population	25,143,380	3,192,764	346,169	164,448	28,846,761
Percent of Total Population	87.2	11.1	1.2	0.6	100.0

For the statistical area classification (SAC), Statistics Canada recommends that the “north” category include only the region north of the north transition line (the mean plus one standard deviation). Because of the inherent variability near the north–south line, selection of the north transition line to define the north category in the statistical area classification was considered the better choice of the two (see Appendix 1, Map 4). As well, this retained 4,732 CSDs within the MIZ classification.

⁴ The MIZ classification tags census subdivisions (CSDs) outside of census metropolitan areas (CMAs) and census agglomerations (CAs) according to the degree of influence that CMAs and CAs have on the CSD. Influence is measured by the percentage of a CSD's resident labour force working in the core of any CMA or CA. There are four categories in the MIZ classification based on the total percentage of a CSD's labour force that works in the cores of CMAs or CAs: **strong MIZ** (30% or more); **moderate MIZ** (GE 5% and LT 30%); **weak MIZ** (GT 0% and LT 5%) and **no MIZ** (0%).

⁵ Data from the 1991 Census were compiled according to the MIZ classification and the initial definition of the north based on 4 indicators (see Section 2 on Methodology). In order to be consistent with the CMA/CA and MIZ classification, the north category was also CSD based. CSDs were assigned to the north if their representative point fell north of the north–south line.

⁶ McNiven's application of this classification used 1996 Census CSD profile data. CSDs were assigned to one of the four categories according to the zone into which the CSD's representative point falls.

Table 3, shows 1996 Census population counts according to this proposed statistical area classification by CMA/CA, MIZ and North categories.

Table 3. 1996 Census Population Distribution by CMA/CA, MIZ Categories and North Transition Category

Statistical Area Classification	Total Population (1996 Census)	% Total Population
CMA (South + South Transition + North Transition + North)	17,864,646	61.9
CA (South + South Transition + North Transition + North)	4,585,209	15.9
Strong MIZ (South + South Transition + North Transition)	1,564,700	5.4
Moderate MIZ (South + South Transition + North Transition)	2,363,266	8.2
Weak MIZ (South + South Transition + North Transition)	2,035,581	7.1
No MIZ (South + South Transition + North Transition)	311,162	1.1
North (all MIZ categories north of the North Transition line)	122,197	0.4
Canada Total	28,846,761	100.0

6. SUMMARY

The combination of the MIZ classification and the north concept provides a new **statistical area classification** that can serve as a common denominator to assist internal and external users in the study of Canada and to promote understanding of the north and its characteristics.⁷ The combination of 16 lines, which individually divide the country into north and south, gives a more complete north–south line than a simple model of a dichotomous north and south, and reflects the combined social, biotic, economic and climatic aspects of all the lines. At the same time, the creation of transition areas reflects the gradual change from south to north. These buffer zones add an element to the north–south delineation that, although not extensively evaluated, creates a new way of looking at Canada.

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⁷ Custom retrievals from the 1996 Census database are now possible using the combined MIZ and North classification.

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LIST OF MAPS

Map 1. Selected North-South Indicators

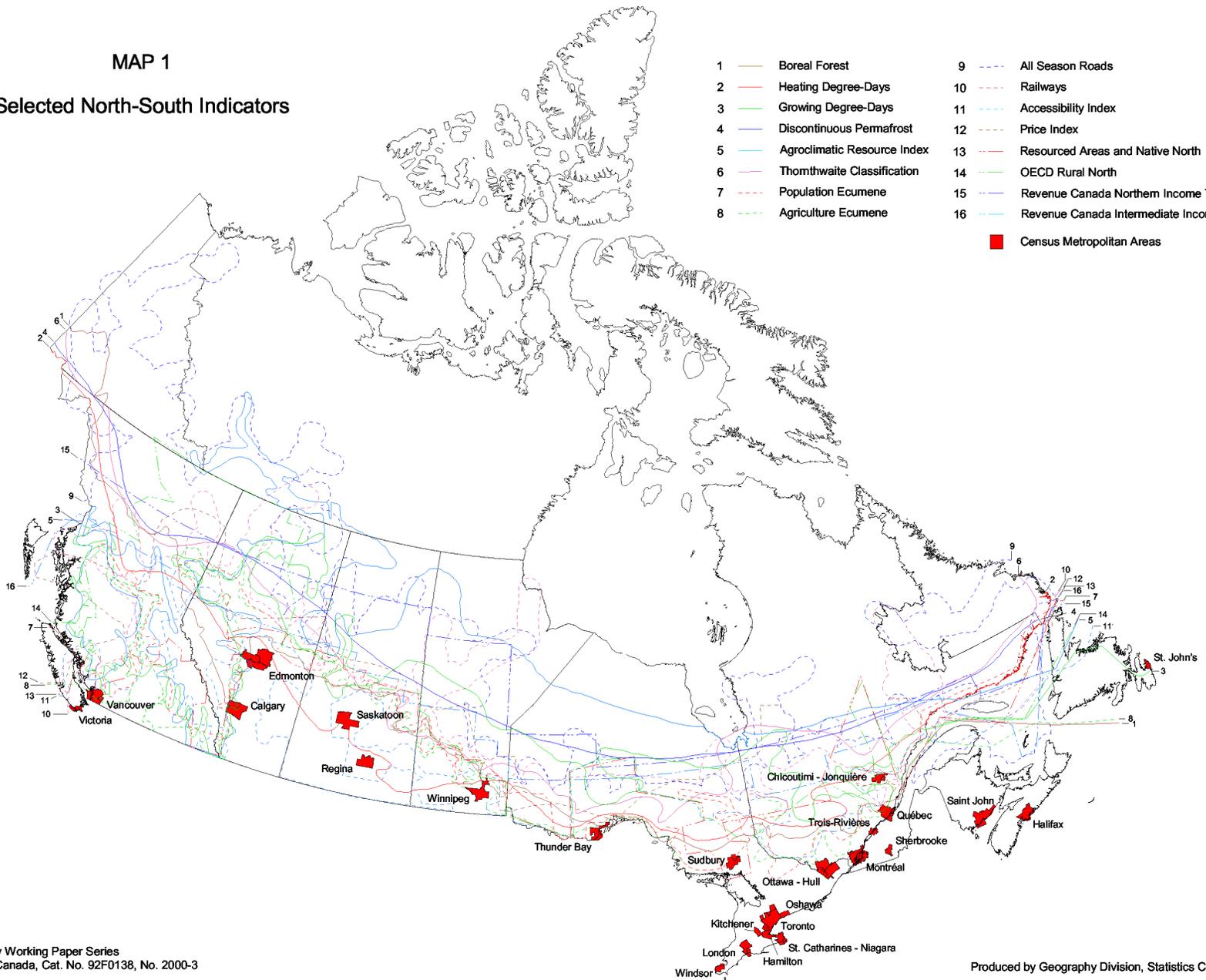
Map 2. North–South Line and Transition Lines (unsmoothed mean, +/- 1 standard deviation)

Map 3. North–South Line and Transition Lines (Comparison of Unsmoothed and Smoothed Lines)

Map 4. Selected North-South Indicators and Smoothed North–South and Transition Lines

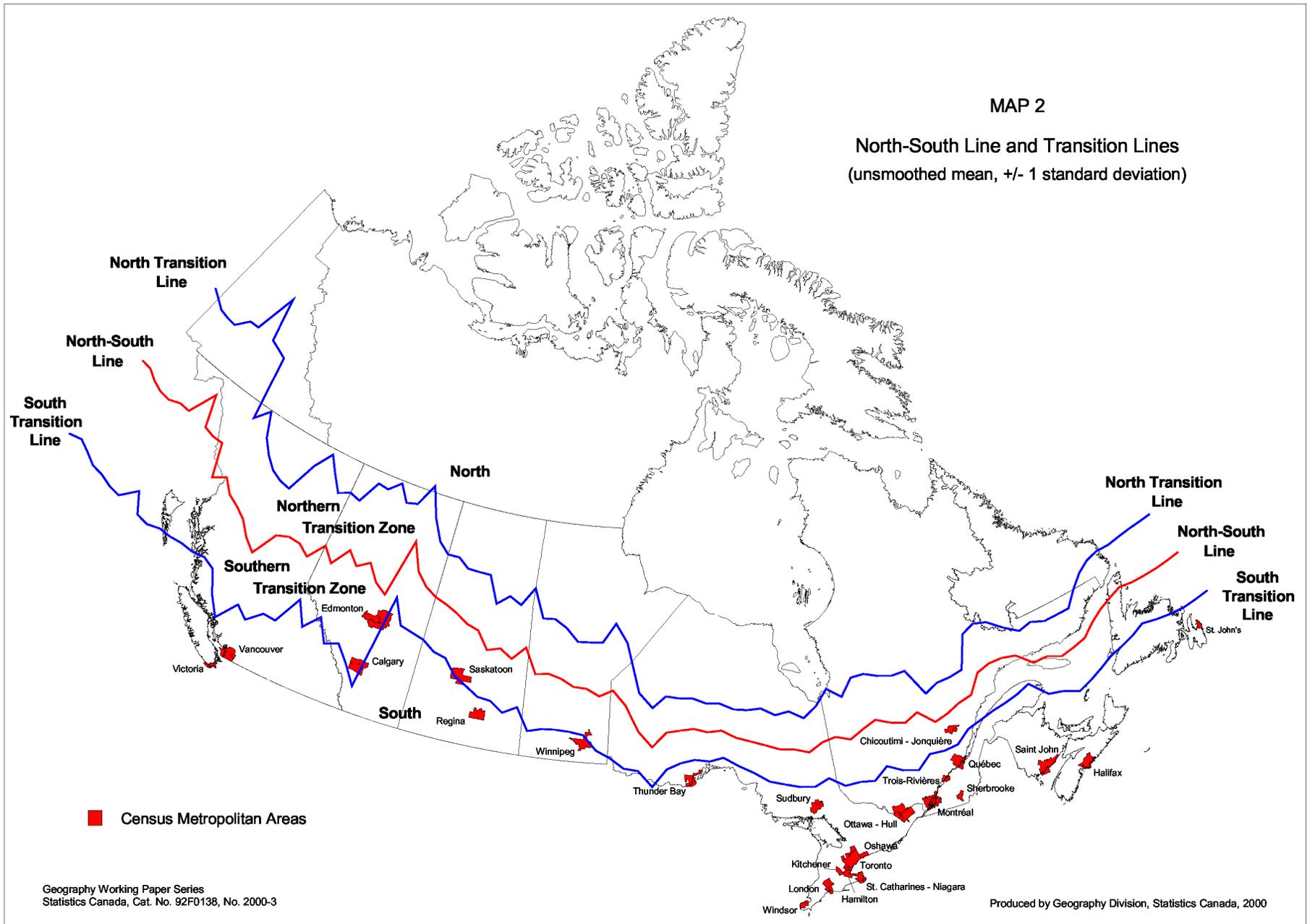
MAP 1
Selected North-South Indicators

- | | |
|---------------------------------|--|
| 1 — Boreal Forest | 9 - - - All Season Roads |
| 2 — Heating Degree-Days | 10 - - - Railways |
| 3 — Growing Degree-Days | 11 - - - Accessibility Index |
| 4 — Discontinuous Permafrost | 12 - - - Price Index |
| 5 — Agroclimatic Resource Index | 13 — Resourced Areas and Native North |
| 6 — Thornthwaite Classification | 14 — OECD Rural North |
| 7 - - - Population Ecumene | 15 — Revenue Canada Northern Income Tax Zone |
| 8 - - - Agriculture Ecumene | 16 — Revenue Canada Intermediate Income Tax Zone |
| | ■ Census Metropolitan Areas |



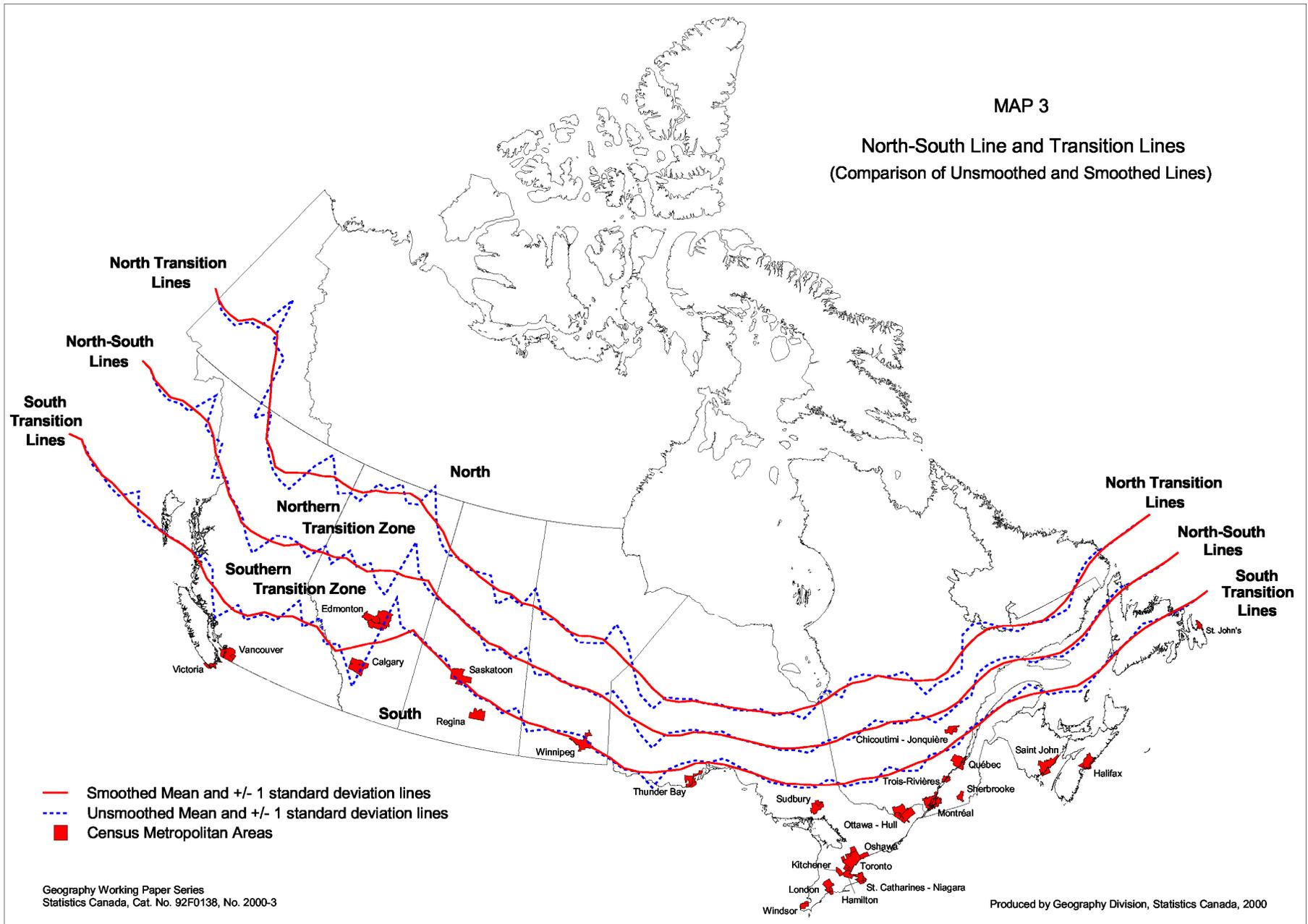
MAP 2

North-South Line and Transition Lines
(unsmoothed mean, +/- 1 standard deviation)



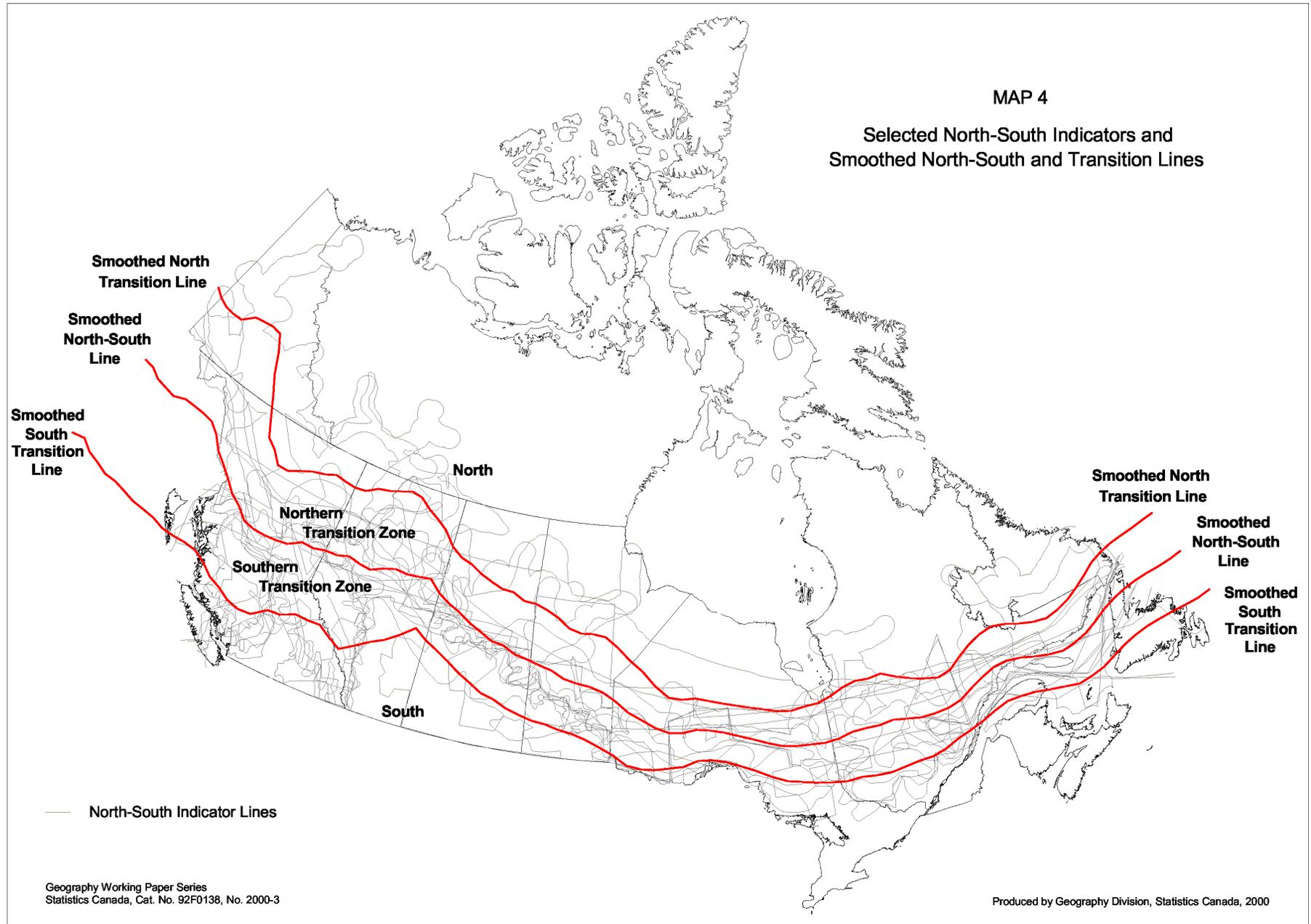
MAP 3

North-South Line and Transition Lines
(Comparison of Unsmoothed and Smoothed Lines)



MAP 4

Selected North-South Indicators and
Smoothed North-South and Transition Lines



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