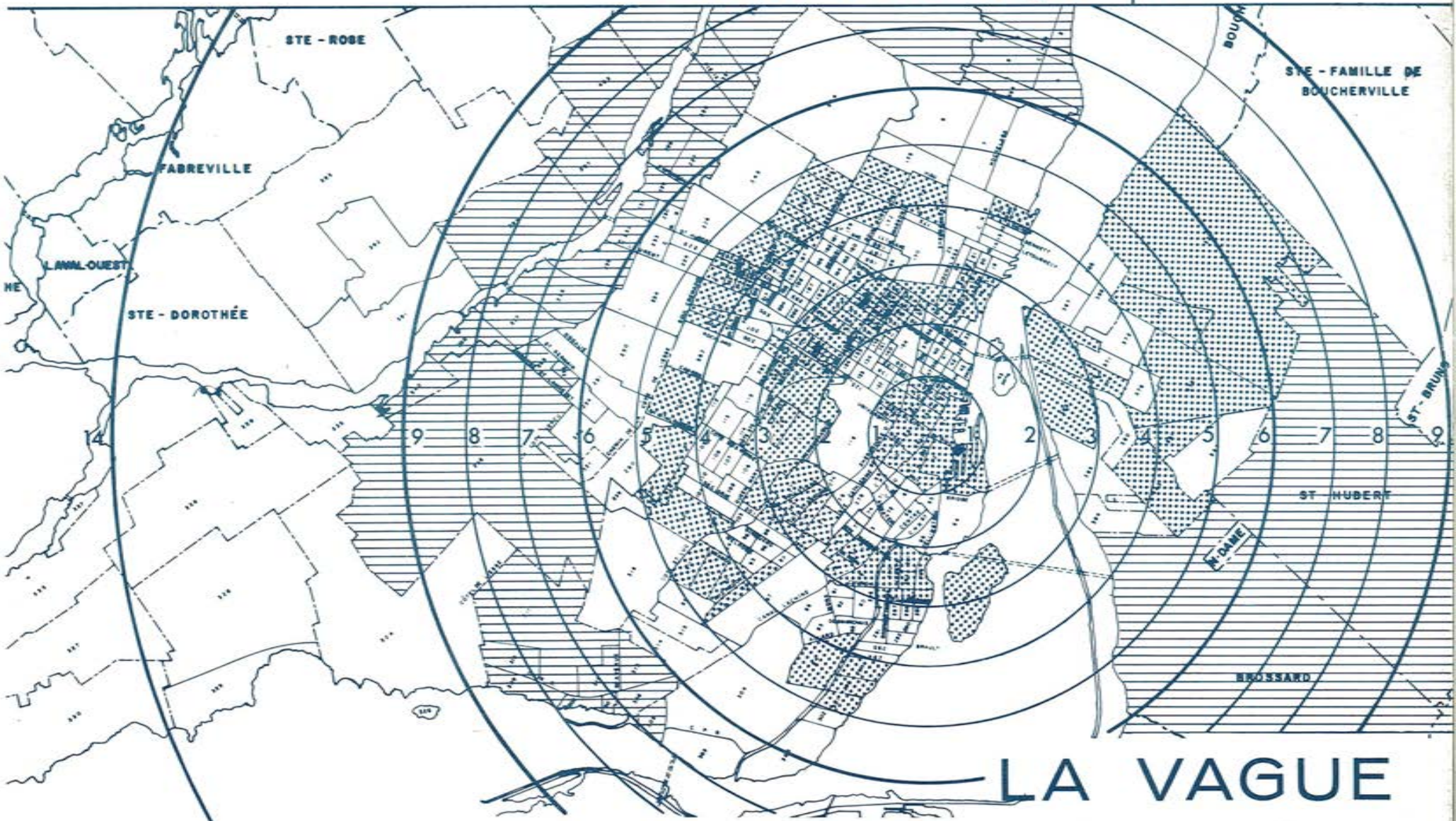
Service d'Urbanisme
Ville de Montréal

janvier 1964

27

BULLETIN TECHNIQUE

no. 1



LA VAGUE D'EXPANSION MÉTROPOLITAINE

THE WAVE OF METROPOLITAN EXPANSION

A STUDY OF CHANGES IN DENSITY
IN THE MONTREAL REGION

INTRODUCTION

In December 1963 the Planning Department published the first of its Information Bulletins, entitled "Catalogue of Street Names" (Répertoire des Noms de Rues).

The present work, "The Wave of Metropolitan Expansion" is the first of a new series of publications, presented in the form of Technical Bulletins.

Information Bulletins are published with the object of bringing to the attention of the general public information of a general interest such as the official names of streets and their origin. In this way they reach a very wide audience.

Technical Bulletins, on the other hand, will interest mainly the well-informed audience and particularly specialists in the subject. These bulletins deal with the results of certain studies carried out by the Planning Department towards the preparation of a master plan for the region, and these results will, we hope, permit decisions to be made in the light of a more precise knowledge of the region and the factors which influence its development.

The present study shows that Montreal does not flout general rules but obeys, at its own pace, what might from now on be called "the law of the wave of metropolitan expansion." The results obtained are of great importance because they permit us to test the validity of our concepts and to predict, with much more objectivity and realism, the future distribution of population in the region.

Aimé Desautels, arch.
Director

THE AIMS OF THE STUDY

In the course of this study an attempt will be made to determine the location, at different periods, of the zone of highest population density in the Montreal inner region. An attempt will also be made to see if this zone is moving, in what direction, and at what rate.

To be more precise, this study is concerned with:

(a) a description of the distribution of population in the Montreal inner region, as well as changes in that distribution between 1941 and 1961, according to distance from the center;

(b) a verification of whether the theory of the "tidal wave of metropolitan expansion," as set out by Hans Blumenfeld, is applicable to Montreal.[1] It is a matter of verifying the following hypotheses:
- In large urban agglomerations, population density decreases with increasing distance away from the center towards the periphery.
- Over a long period, population density tends to increase in each successive zone.
- With time, density becomes uniform over a greater and greater area.

METHODS OF WORK

Distance, and more particularly the distance from the downtown area, is one of the factors determining population distribution in urban agglomerations. Several authors have tried to explain variations in certain urban phenomena by linking different factors to distance from the center. For this purpose a grid of concentric zones is used. In certain cases it has been demonstrated that some urban phenomena behave in an approximately concentric way, but in several cases this sort of analysis appears very artificial. The relative differences between one sector and another - differences due to the linear behavior of certain phenomena - are then neglected. Homer Hoyt has demonstrated that some given sectors, even though distributed across several concentric zones, have similar characteristics. Thus, in some cases the concentric zone method of analysis proves more valuable than sector analysis, and vice versa. In some other cases, it is clearly preferable to combine the two methods of analysis.[2]

In the present case - that of population distribution - Blumenfeld has shown that the concentric zone method is valuable. But it does not take into account relative differences which exist between different sectors: the analysis must stick to measures of average density which apply to the whole of each of the respective concentric zones. The existence of secondary urban centers affects the population density in certain parts of the concentric zones but does not affect the average density measured over the whole concentric zone.

The center of the system of concentric zones

The majority of American authors have taken the city hall as the central point of the City. We have rejected this practice for the following reasons:

(a) If the city hall were taken as center there would be too small a proportion of dry land in the first concentric zone;

(b) If the city hall were taken as center we would obtain, in our view, a first concentric zone which displaces the downtown area much too far to the east. The eastern and western limits of such a zone lie in the proximity of De Lorimier Avenue and Peel Street respectively. (See map no. 1.)

The center finally chosen is situated more to the west, on the boundaries of census tracts, at the intersection of Craig and McGill Streets.

The exact boundaries of the downtown area of Montreal have not yet been definitely established. Nevertheless, studies in progress permit the affirmation that the east boundary of the downtown area should not be located very far beyond Saint-Denis Street.

The intersection of McGill and Craig Streets does not necessarily constitute the geographic "center" of the city. At the most, it is a question of the center of a system of concentric zones. The center of the city cannot be considered in the abstract, like a point in space. Rather, the center appears as a given area located in the first concentric zone of one-mile radius. Evidently, the downtown area "floats" a bit in space. The choice of the center around which the concentric zones will be drawn is of importance especially in the case of the first concentric zones. A displacement of the center, even of a few tenths of a mile, permits the choice of a first, central concentric zone which more or less covers the real downtown area. But, as distance towards the periphery increases, a displacement of the center by a few tenths of a mile loses significance.(3)

The concentric zones

It is impossible to divide the territory of an urban area like Montreal into concentric zones without having recourse to certain statistical units. It is important that these statistical units be as numerous as possible so that they can be grouped adequately. In other words, the smaller the statistical units, the more perfect will be the configuration of the concentric zones.

The whole Island of Montreal, plus a part of Ile Jesus and the main agglomerations of the south shore are divided into census tracts; in this area, census tracts were grouped to form concentric zones. Further out, where the zones go beyond the area divided into census tracts, from the seventh mile and beyond, census tracts were combined with municipalities. (See maps nos. 3 and 4.)

From the first to the sixth mile inclusive, the size of the census tracts permitted their grouping into concentric bands one mile in width. However, beyond the sixth mile the area of the tracts and municipalities increases to the point where it became impossible to create belts with a width of less than three miles. The following groups of concentric zones therefore result:

Zones 1 to 6: six zones each one mile in width.
Zone 7 to 9: one zone three miles wide.
Zone 10 to 14: one zone five miles wide.
Zone 15 to 19: one zone five miles wide.
Zone 20 to 25: one zone six miles wide.
Remainder of the inner region: one zone extending from "Zone 20 to 25" up to the confines of the inner region as defined by the research section of the Montreal City Planning Department.(4)

Census tracts and municipalities were grouped into concentric zones in accordance with two criteria:

(a) <u>distance from center</u>: all statistical units making up the same concentric zone should be located at a relatively comparable distance from the center;

(b) the total area (practical) of the statistical units making up a concentric zone should be comparable to the theoretical area of a concentric band one mile in width.

In actual fact, the center-distance of each statistical unit was not measured. Rather, a series of concentric circles (theoretical concentric zones) at one mile intervals was placed over a map showing the census tract and municipal boundaries. To begin with, all statistical units which had more than half of their area within the limits of the theoretical concentric zone were taken as part of that zone. Then the other statistical units were distributed to one zone or another so as to obtain for each concentric zone a practical area comparable to its theoretical area. (See Appendix no. 1.)

The practical area and theoretical area (measured on dry land) of the concentric zones are not exactly the same because the census tracts and municipal areas which make up the practical zone coincide only approximately with the limits of the theoretical zone. It is important that the practical area of each concentric zone correspond as closely as possible to its theoretical area, but it is still more important that the practical areas of the successive concentric zones augment proportionally to the square of their distance from the center, as do the theoretical areas.

Table 1 and chart 1 give an idea of the difference between practical and theoretical areas of the concentric zones for 1961 and 1951-41.(5)

ANALYSIS OF DATA

The distribution of population could be studied by taking the whole inner region of Montreal together. But, to permit finer conclusions to be drawn, this distribution can be studied on three different levels: the inner region as a whole, the Island of Montreal, and the City of Montreal itself.

In so proceeding it cannot be pretended that the influence of the south shore and Ile Jesus on Montreal, or the influence of the latter on the former, are eliminated. There exists but one single environment of which all parts are interdependent, but perhaps the method of analysis will permit the discernment of certain elements of this interdependence and a clarification of their influence.

All concentric zones (from 0 to 25 miles - or more precisely up to the 21st mile) include portions of Montreal Island. (See map no. 4.) Taking into account only the Island of Montreal, Ile Jesus is eliminated as well as the north shore, the south shore, and part of Vaudreuil and Soulanges.

Only concentric zone no. 1 is wholly within the limits of the City of Montreal. With zone no. 2 is included a part of Westmount. But, since the City extends from one river bank to the other, all zones from the first mile to the seventh contain a smaller or greater part of the City of Montreal. Taking in only the City eliminates all other Island municipalities together with those on the south shore that are included in these concentric zones.

The areas(6)

The Montreal inner region, as defined by the City Planning Department,(7) has a total area of some 2,000,000 acres, which corresponds pretty closely to the area of a circle with a radius of 32 miles.

As can be seen from map no. 4, all concentric zones, from the first to twenty-fifth mile, are included within the inner region. For all practical purposes the rest of the inner region (the inner region less the 0-25 mile concentric zones) is considered another concentric zone. This supplementary concentric zone is much larger than the others and measures some 925,000 acres.(8)

For the Island of Montreal, an area of some 110,000 acres was used (see table no. 2), and for the City of Montreal, an area of about 30,000 acres.(9)

Population distribution by concentric zone

Examining the distribution of population (in absolute numbers) by concentric zone, it will be seen that the zone which had the highest population in 1951 and 1961 is, in general, that of the fourth mile.(10) In 1941, the 4-mile zone remains the concentric zone with the highest population in the case of the inner region and of the Island of Montreal. However, the population of the 3-mile zone was then nearly equal to that of the 4th mile. In the case of the City of Montreal, on the other hand, the maximum population occurs in the 2-mile zone, but it is but little higher than the population of the 4-mile zone.

In the case of the City of Montreal and of the Island, the zones where the population is least are, as might be expected, the peripheral ones. It can also be noted that the population is relatively minute in the 1-mile zone; in 1961, in the case of the City of Montreal, the population there was even below that of the peripheral zones.

If the inner region as a whole is considered, it is no longer the peripheral zones where the population is lowest. In 1941, the lowest population was found in the 6-mile zone (and probably on a plateau going from the 6th to 15th mile if the populations of the 7-, 8-, and 9-mile zones were not artificially accumulated). From 1941 on, and the tendency continued until 1961, there were more people living in the satellite towns (located in the 15-19, 20-25, and remainder-of-region zones) than in the so-called suburban towns (Jesus Island and south shore). However, in 1961, there can be noted a levelling out of the population from the 20-mile zone and beyond. Once again it is noted that the population of the 1-mile zone (the center) is very small; in 1961 this was the least populated zone.

From the first to third mile inclusive, the proportion of the population by concentric zone with respect to the total population of the inner region, of the Island of Montreal, or of the City of Montreal, decreased between 1941 and 1961.(11) In these three concentric zones, the population was in fact diminishing in absolute terms, and not merely in a proportion due to the increase in the population as a whole.

Between 1941 and 1961, the total population loss in these three concentric zones (first to third mile inclusive) was from 87,000 to 100,000 inhabitants.(12)

In 1941, these three concentric zones contained 45.4% of the total population of the inner region as against 22.2% in 1961; they contained 56.5% of the population of the Island of Montreal in 1941 against 30.6% in 1961 and 60.7% of the City population in 1941 against 38.0% in 1961.(13)

In Philadelphia, in fifty years, the loss of population was around 11,000 in the group of three first central zones. In Montreal, the decrease in population in a single concentric zone and during one single decade was equally as great and sometimes double that.

It could be said that Montreal, in contrast to Philadelphia, has experienced the phenomenon of decentralization. On the basis of a study in progress it can be stated that there is definitely a migration of residents towards the periphery and an invasion of the center by non-residential establishments.(14)

The 4-mile zone does not have the same characteristics as the other zones. This zone bridges between zones where population is diminishing (zones 1, 2 and 3) and zones where the population is increasing (zones 5 and following). In the 4-mile zone the population increased between 1941 and 1961 by 130,400 persons in the City of Montreal, by 150,700 within the Island of Montreal, and by 191,200 in the whole region. However, the proportion that this population bears to the total population of the inner region, the Island of Montreal, or the City of Montreal, is a stable one.(15)

In the other concentric zones, from the 5th to 25th mile, the contrary occurs: in each zone the population is increasing not only in absolute numbers but in proportion to the total. Only the 20-25 mile zone is an exception, behaving more like the 4-mile zone.

To simplify this presentation, the changes in population in each decade by concentric zone have been expressed as a percentage.(16)

At first glance the most striking thing, whether at the level of the inner region, the Island of Montreal, or the City of Montreal, is the contrast between the two decades 1941-1951 and 1951-1961.

Examining first the case of the inner region taken as a whole,(17) one first notes an important increase in the rate at which the population of the 1-mile zone is decreasing, from one decade to the other. Between 1941 and 1951 the population diminished at a rate of 4.7% and between 1951 and 1961 at a rate of 36.8%, eight times greater.

In the 2- and 3-mile zones the rate of decrease of population doubled from one decade to the next.

The 4-mile zone is characterized by a stable rate of population increase; the population increased there at about the same pace over the course of the two decades. This is, in addition, the closest zone to the center whose population is increasing.

In the 5-mile zone, contrary to what might be expected, the population increased at a lower rate between 1951 and 1961 than it did between 1941 and 1951. This is also the only concentric zone whose population was increasing which had a lesser rate of increase in the second decade than in the first.

The 4-mile zone, characterized by a stable rate of population increase, and the 5-mile zone, characterized by a decreasing rate of population increase, make a bridge between the zones where population is decreasing at an increasing rate (zones 1, 2 and 3) and the zones where the population is increasing at an increasing rate (zone 6 and following).

The 6-mile zone is the one which had the highest rate of population increase of all zones in the course of the two decades: 108.9% between 1941 and 1951, and 191.9% between 1951 and 1961.

In the other successive concentric zones, the rate of population increase doubled from one decade to the other (it tripled in the 10-14 mile zone), with the exception of the 20-25 mile zone and the "remainder-of-inner-region" zone.

These last two zones behaved rather like the 4-mile zone. Their rates of population increase came close to the average rates whether the Island, the City, or the inner region as a whole is considered. Since the population of each of these zones is increasing at close to the same pace as that of the whole (region, Island, or City), the relationship between the population of these zones to the population of each ensemble remains stable.(18)

When only the Island of Montreal is considered, the incidence of the municipalities of the south shore, Ile Jesus, and the north shore is diminished. It is interesting to compare the rates of change in population by concentric zone on the Island of Montreal with those for the whole inner region. From the first to sixth mile inclusive there is not much difference. In most other cases the rates of population change of the Island of Montreal are less high than those of the inner region. It could thus be supposed that the south shore municipalities together with those of Ile Jesus and the north shore, which are accounted for in the inner region, have a higher rate of population change than those of the Island of Montreal. However, two exceptions are noted: in the 10- to 14-mile zone, the rate of population change for the Island of Montreal was, during the decade 1941-51, greater than the rate for the inner region; in the same way the 15- to 19-mile zone exhibited, for the Island of Montreal in the decade 1951-61, a rate of change much greater than that of the inner region. From a rate of 21.2% for the 1941-51 decade, the rate of population increase went to 449.1%. Without doubt this change is due to the development of the western end of the Island of Montreal (Kirkland, Beaconsfield, Baie d'Urfé, Sainte-Anne de Bellevue, Pierrefonds, Sainte-Geneviève, etc...).

Considering only the City of Montreal, that is, taking out other municipalities on the Island of Montreal, about the same changes occur as when comparison was made between the inner region and the Island. The rates of population change are practically identical to those of the Island and inner region in the first concentric zones from the 1-mile zone to the 4-mile zone inclusive. This is explained by the realization that the first three concentric zones are on the Island of Montreal and almost entirely within the City of Montreal. (See map no. 1.) The rates of population change for the

4-mile zone are almost identical for the inner region, the Island of Montreal and the City of Montreal. One may therefore conclude that at a distance of four miles from the center the population is increasing at the same pace in the south shore municipalities, in those situated on the Island of Montreal, and in the City of Montreal itself.

Comparing rates of population change over the two decades in the other concentric zones (5-, 6- and 7-9 mile) as between the City of Montreal and the Island of Montreal, it can be seen that in some cases the population is increasing more rapidly in the City than in the neighboring towns, and that in some cases the reverse is occurring. For example, during the 1951-1961 decade in the 5-mile zone the population increased more rapidly in the surrounding municipalities than in the part of the City of Montreal which is located in this concentric zone. The same is true of the 6-mile zone during the 1941-51 decade, and in the course of the following decade in this same zone, a considerable reversal is noted. All of the municipalities of the Island included in the 6-mile zone had a rate of change of 183.1%. In contrast, the rate of change for that part of the City of Montreal included in this zone was 369.2%. This rate of increase of 369.2% is doubtless due to the intensive development of the residential districts situated in the northern part of the City (Rosemont, Villeray, Ahuntsic). This tendency could already be discerned between 1941 and 1951; the 6-mile zone was already the one where the rate of population increase for the City of Montreal was the highest.

These rates of population change have been put in the form of graphs.(19) It is from such curves of rates of population change that Blumenfeld measured, in Philadelphia, the rythm of progress of the wave of metropolitan expansion. He describes these curves in the following way: "... the five curves, representing changes during five decades, follow a similar pattern, regardless of their flatness or steepness. They all rise relatively steeply to a peak, then decline more slowly and flatten out. In every decade there is a zone of maximum growth, sometimes narrower, sometimes broader, which we may define as the crest of the tidal wave of metropolitan expansion. This crest moves slowly and fairly regularly to the right, from the center toward the periphery. ... this zone has moved four miles in four decades."(20)

The curves of rate of population increase which we have obtained are comparable to those obtained by Blumenfeld for Philadelphia. The boundaries of municipalities have relatively little influence on the distribution of population in an urban entity with the breadth of Montreal. The curves of rate of population increase point up the reality even more for the Island of Montreal and for the inner region. One has to do, in fact, with a single urban agglomeration whose center is located on the Island of Montreal and an agglomeration which flows beyond the Island's boundaries.

It is at the level of the inner region as a whole that one can above all discern the movement of the tidal wave of urban expansion from the center towards the periphery. (See chart no. 2.) The "crest of the wave of expansion" was situated, between 1941 and 1951, at nine and one-half miles from the center; between 1951 and 1961 it had arrived at a point twelve and one-half miles from the center. In the course of the last two decades, therefore, the crest of the wave of expansion travelled three miles.

Nevertheless, it is important to note that our comparison extends over only two decades. The three-mile displacement of the crest of the wave of metropolitan expansion is probably not constant. The rate of displacement is comparable enough with what Blumenfeld found for Philadelphia (4 miles in the course of four decades) but it could not be considered a measure which could be used with confidence. Since this analysis covers a limited time period, one must be content merely to conclude that it seems evident that in the Montreal inner region the wave of metropolitan expansion is moving from the center towards the periphery and that it progressed three miles between the last two decades.

Changes in gross density by concentric zone(21)

In this study the term gross density means the ratio between the total population and total area. The gross density for each concentric zone was obtained by dividing the total population of each zone by its total area.

It was indicated earlier that the concentric zones were formed sometimes of groups of census tracts alone, sometimes

of groups of census tracts and municipalities combined, and sometimes of municipalities alone, depending on whether the concentric zone covered more or less exactly that part of the area of the Montreal region which is divided into census tracts. When the term total population is used, it means, for each concentric zone, the sum of the population of all the census tracts (and/or municipalities) which form the particular concentric zone.

The 1961 area of each municipality having been measured previously, measures of gross density by each individual municipality were available for the inner region for 1961. For 1951 and 1941 only the average density by concentric zone is available.

For the inner region as a whole the gross density, which was 0.67 persons per acre in 1941, went to 0.84 persons per acre in 1951 and was 1.19 persons per acre in 1961. On the Island of Montreal the density is higher than that of the whole region. It increased at the same pace: 10.3, 12.2, and 15.6 persons per acre in 1941, 1951, and 1961 respectively. For the City of Montreal the gross density went from 29.2 persons per acre in 1941 to 33.1 persons per acre in 1951 and finally to 39.1 persons per acre in 1961.

The curves of gross density for the inner region, the Island of Montreal and the City of Montreal are relatively similar. Nevertheless, a comparison of the three series of curves brings out some important differences.(22) In the first two concentric zones, in all cases - the region, the Island and the City of Montreal - the gross density diminished from one decade to the next. (Table 8 is to be read vertically in this instance.) The decrease in density is less in the 2-mile zone than in the 1-mile zone but density remains high - the inner region figures (table 8) are 61.7 persons per acre in the 2-mile zone in 1941 as against 51.0 persons per acre in 1961.

In spite of this drop in density, the 2-mile zone was the zone of highest density in 1941 and 1951. But the 2-mile zone lost this characteristic in 1961 to the profit of the 4-mile zone in the case of the Island of Montreal and of the 3-mile zone in the case of the City of Montreal.

MAXIMUM GROSS DENSITY

	1941	1951	1961
	(Concentric zones)		
Inner region	2	2	2
Island of Montreal	2	2	4
City of Montreal	2	2	3

Between the 2- and 3-mile zones a reversal is noted. In each of the succeeding concentric zones, density increases from one decade to the next. (In the case of City of Montreal figures, this reversal is produced between the 3- and 4-mile zones; see chart no. 8.)

Between 1941 and 1961 the density in the different concentric zones increased as follows:

Concentric zones	Increase in gross density (persons per acre)
3	+ 1.6
4	+ 17.1
5	+ 10.8
6	+ 9.6
7 to 9	+ 3.3
10 to 14	+ 0.72
15 to 19	+ 0.38
20 to 25	+ 0.12
0 to 25	+ 0.89
Remainder of inner region	+ 0.06
Inner region as a whole	+ 0.52

From the 10-mile zone on, the increase is negligible but, on the other hand, it is important in the 4-, 5- and 6-mile zones. These are the zones of "infilling" while the other peripheral zones (10-mile and beyond) appear as zones of "expansion."

The changes in density from one zone to the other are fairly similar from one year to the next. Each curve presages the following one. In 1941 and 1951, from the 10-mile zone on, density decreases in proportion to increasing distance, from the center to the periphery. In 1961, there is an exception at the 4-mile zone; density there is greater than in the preceding zone. This increase in the density of the 4-mile zone seems to be foreshadowed by the curves for 1941 and 1951. Blumenfeld's curves of density for Philadelphia and Toronto do not present such irregularities. It would be necessary to make a detailed examination of the sectors of the 4-mile zone to determine the possible cause of such an increase in density.

Comparing the density curves for Toronto and Montreal it can be seen that (1), the density is generally higher in Montreal than in Toronto, and (2), the highest densities in Toronto form a plateau which extends over three concentric zones (2nd, 3rd and 4th) while in Montreal the highest densities are concentrated in a single zone, that of the 2nd mile. Nevertheless, there is a discernible tendency in Montreal between 1941 and 1961, to the enlargement of the zone of highest densities.

Reduction of this data to a common denominator permits a clarification of the analysis. Density for each concentric zone has been expressed as a percentage of the average density of the whole (calculations being made for the three cases: inner region, Island of Montreal and City of Montreal). (23)

The case of the inner region is first to be examined (table no. 9 and chart no. 6).

Density decreases in the first, second, and third zones. The rate of decrease is the same for the three curves between 1941 and 1951, but the rate lessened between 1951 and 1961. Each curve is intimately linked to the preceding one. If one part of a curve has a rate of change (on the increase or decrease) greater or lesser than that of the part of the curve which precedes, it can be concluded that the rate of change will go in the same direction on the following curve.

These curves are of three types:

1) Density diminishes with respect to the overall density (zones 1, 2 and 3);

2) Density increases with respect to the overall density (zones 5, 6, 7 to 9, 10 to 14, and 15 to 19);

3) Density of the concentric zone is relatively stable with respect to the overall density (zones 4, 20 to 25, and remainder of inner region).

All zones in which density relative to overall density is decreasing have a density greater than the density overall and are located in proximity to the center (zones 1, 2 and 3). In zones 5, 6, and 7 to 9, density is increasing in relation to overall density, and these zones all have a density greater than the overall density. On the other hand, in zones 10 to 14, and 15 to 19, density is also increasing with respect to overall density, but these zones have a density lower than the overall density.

Of the two zones whose density is relatively stable with respect to the whole, one has a density greater than the overall density (zone 4) and the other has a lesser density (zone 20 to 25).

These facts can be summarized more clearly in the following way:

Density diminishing, increasing or remaining stable with respect to density of the inner region	in concentric zones numbered:	This density is greater (>), or lesser (<) than the density of the inner region
diminishing	1, 2 & 3	>
increasing	5, 6 & (7 to 9)	>
	(10 to 14) & (15 to 19)	<
remaining relatively stable	4	>
	(20 to 25) & the remainder of the inner region	<

It can therefore be concluded that Montreal is undergoing the phenomenon of "decentralization." The center is undergoing an important loss of population and a strong decrease in density of population. Nevertheless, the central density is greater than the average density. In the following zones where density is increasing, the average density is exceeded in those zones closest to the center (zones 5, 6, and 7 to 9) but is not yet reached in the zones furthest away from the center (zones 10 to 14, and 15 to 19).

The concentration of population is not yet noticeable in zone 20 to 25 and in the remainder of the region.

CONCLUSIONS

A certain number of conclusions are brought out by this analysis:

1. The period studied here (1941 to 1961) is too short to permit an explanation of whetner the tendencies discovered are recent or very old. For the same reason it is not possible to say whether the rates of change in population and in density by concentric zone are stable or variable.

2. Population, both in absolute number and as a proportion of the population of the whole region, is diminishing in the central zones.

3. The population increased at a rate higher than the average rate of increase of the region in the zones from the 4th to 22nd mile between 1941 and 1951, and in the zones from the 4th to 25th mile between 1951 and 1961. The demographic expansion is spreading out over a larger and larger area.

4. From the 2-mile zone on (with the exception of the 1-mile zone), density decreases with increasing distance from the center towards the periphery.

5. In each concentric zone and from one decade to the other, density diminishes in the first two zones and increases in all other zones, being almost stable in the 3-mile zone.

6. The population of the City of Montreal with respect to the population of the Island of Montreal is gradually diminishing. The population of the Island of Montreal with respect to the rest of the inner region is also gradually diminishing. The population of the inner region is increasing in relation to the population of Quebec and of Canada.

7. The concentric zone with the greatest increase in population in each decade (the crest of the wave of metropolitan expansion) shifts from the center towards the periphery.

It can also be added that this wave of metropolitan expansion is moving, in Montreal, at the rate of 3 miles each decade. Between 1941 and 1951 it was located between 9 and 10 miles from the center; and, between 1951 and 1961, it was located between the 12th and 13th mile. If this pace is constant, it will be located between the 15th and 16th mile in 1971.

Appendix No. I

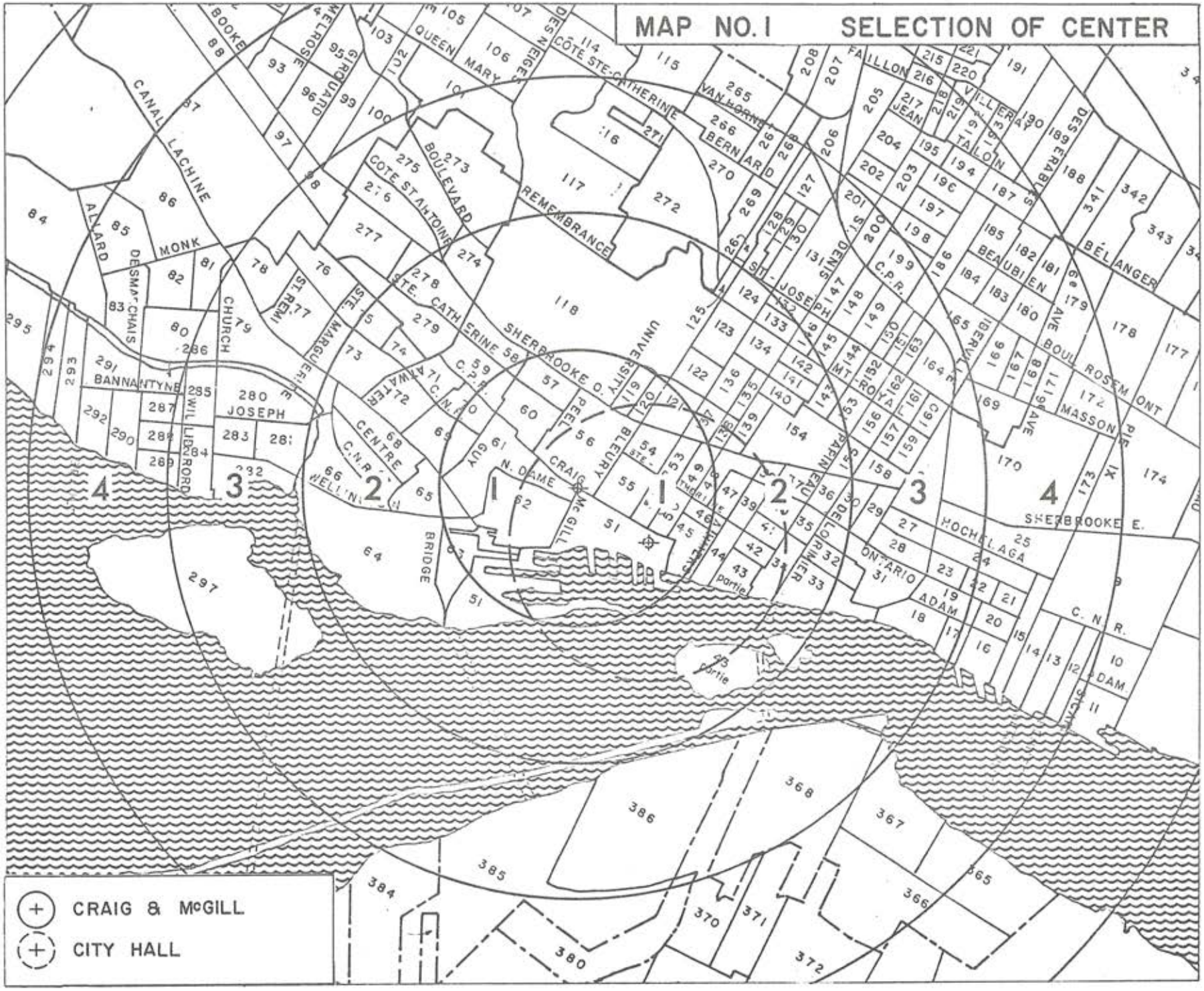
Practical Area and Theoretical Area

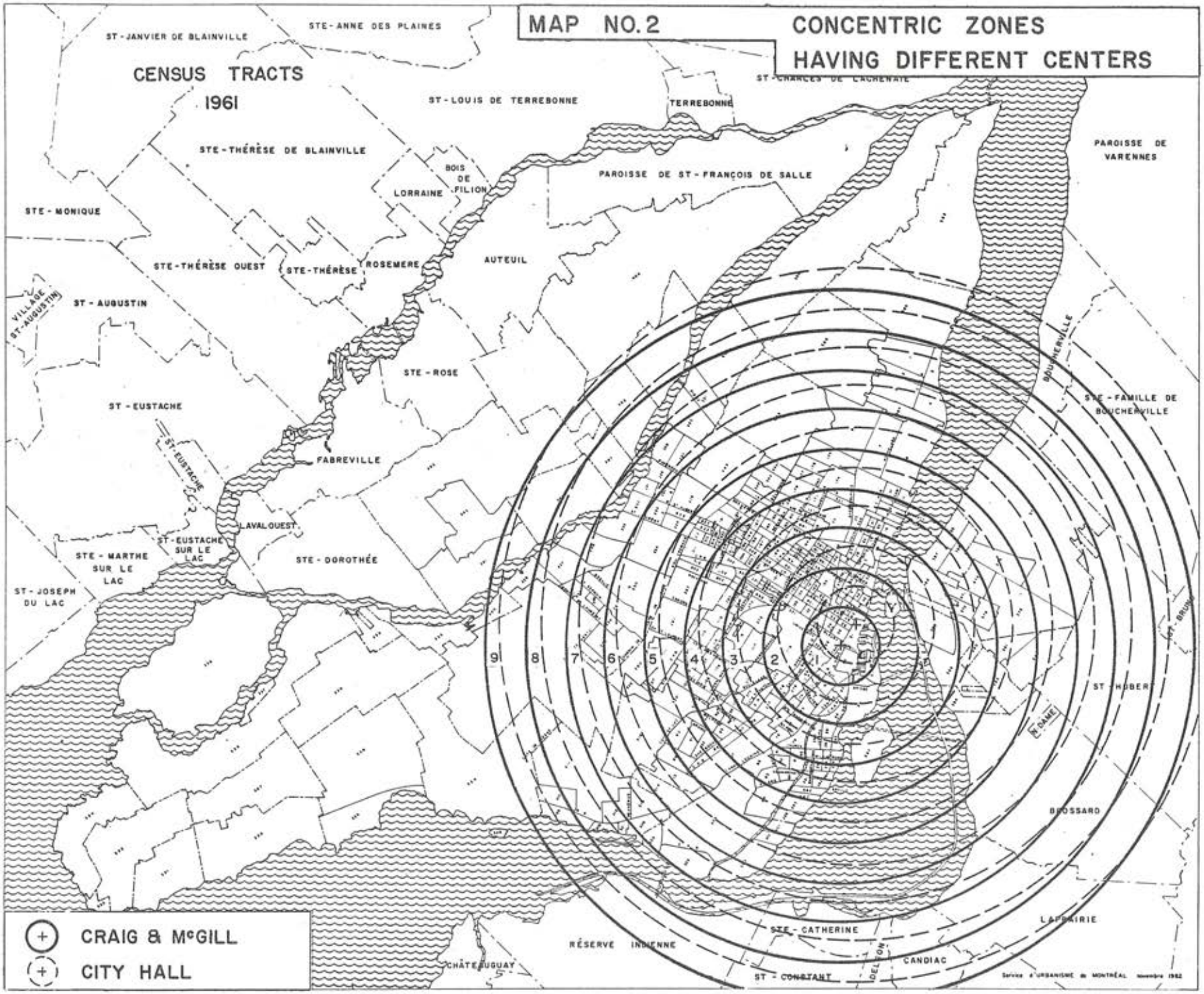
When the terms practical area and theoretical area are used it is a matter, in both cases, of the area of dry land. Water surfaces having a width greater than 100' have been eliminated.

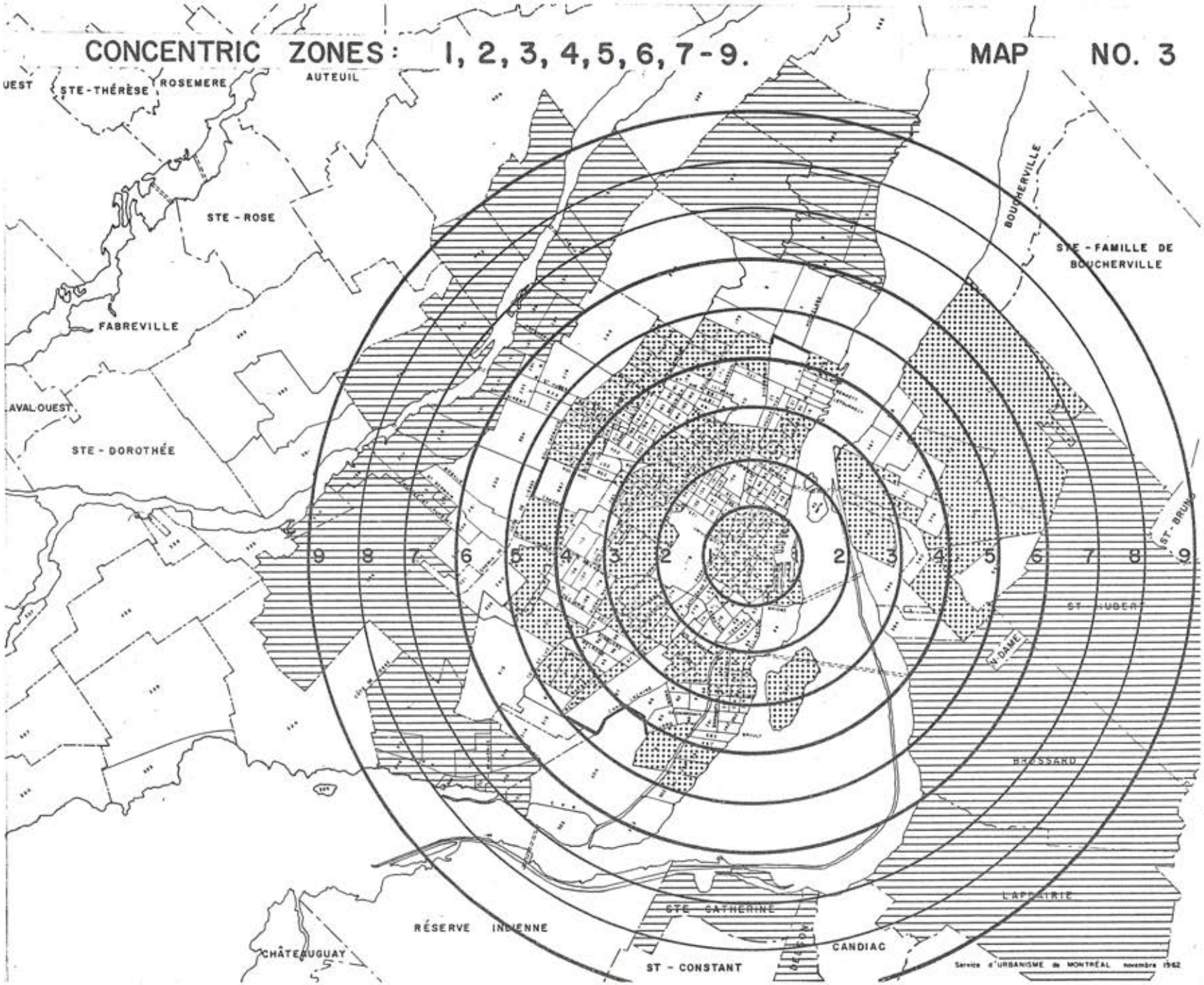
The area of the 1961 census tracts was measured by planimeter after the census tract boundaries had been transcribed as exactly as possible onto an Army Survey Establishment map at a scale of 1:25,000. For 1951 (and 1941 - the same boundaries) only those tracts were measured whose boundaries did not exactly correspond to the 1961 census tract boundaries.

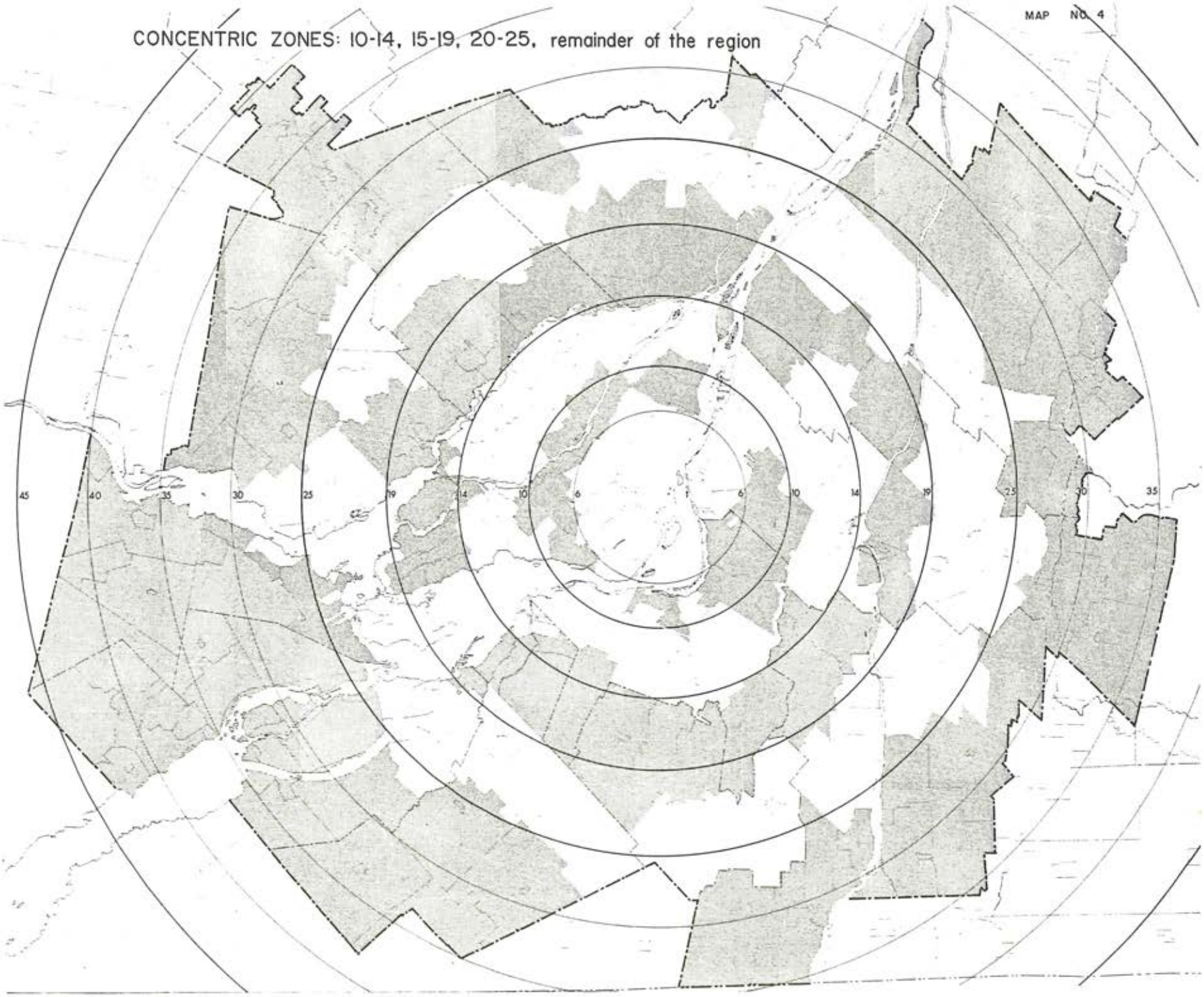
The municipal boundaries of 1961 were also traced as exactly as possible onto an Army Survey Establishment map, at a scale of 1:50,000, on the basis of county plans published by the Provincial government, and in certain cases, plans published by the municipalities concerned. The calculation of areas was done with a planimeter, taking the mean of three readings of the vernier scale.

Due to changes in municipal boundaries, municipal areas for 1941 and 1951 were not measured. A map of 1951 municipal boundaries was established, taking into account boundary changes. Instead of measuring the 1951 area of each individual municipality a process of readjusting the total practical area of the concentric zones was carried out. This explains, in part, the differences in practical areas between 1961 and 1941-51. (See table no. 1.) Changes in census tract boundaries also partly explain these differences. Since it was impossible to obtain a map of 1941 municipal boundaries, the practical area of the 1951 concentric zones was used for each concentric zone of 1941.









COMPARISON OF ACTUAL AND THEORETICAL AREAS BY CONCENTRIC ZONE FOR 1941 - 1951 - 1961

TABLE NO. 1

Zones	Years	(1) Theoretical Area (acres)	(2) Water Area (acres)	(3) Theoretical Area of Dry Land (acres)	(4) Practical Area of Dry Land (acres)	(5) Theoretical Area less Practical Area (3) - (4)	(6) Practical Area as a % of Theoretical Area
Zone 1	1941-51	2,011	271	1,740	1,768	-28	101.6
	1961	2,011	271	1,740	1,768	-28	101.6
Zone 3	1941-51	6,032	1,634	4,398	4,243	+155	96.5
	1961	6,032	1,634	4,398	4,463	-65	101.4
Zone 3	1941-51	10,053	1,798	8,255	8,102	+153	98.1
	1961	10,053	1,798	8,255	7,489	+766	90.7
Zone 4	1941-51	14,074	2,818	11,256	11,167	+89	99.2
	1961	14,074	2,818	11,256	11,149	+107	99.0
Zone 5	1941-51	18,096	3,667	14,429	16,316	-1,887	113.1
	1961	18,096	3,667	14,429	15,358	-929	106.4
Zone 6	1941-51	22,117	4,025	18,092	17,879	+213	98.8
	1961	22,117	4,025	18,092	18,550	-458	102.5
Zone 7 to 9	1941-51	90,478	9,633	80,845	73,190	+7,655	90.5
	1961	90,478	9,633	80,845	73,930	+6,915	91.4
Zone 10 to 14	1941-51	231,222	19,505	211,717	191,706	+20,011	90.5
	1961	231,222	19,505	211,717	200,523	+11,194	94.7
Zone 15 to 19	1941-51	331,753	32,929	298,824	347,109	-48,285	116.2
	1961	331,753	32,929	298,824	322,129	-23,305	107.8
Zone 20 to 25	1941-51	530,805	33,359	497,446	501,203	-3,757	100.8
	1961	530,805	33,359	497,446	503,170	-5,724	101.2
Total	1941-51	1,256,641	109,639	1,147,002	1,172,684	-25,682	102.2
	1961	1,256,641	109,639	1,147,002	1,158,353	-11,351	101.0

TABLE NO. 2

AREA IN ACRES BY CONCENTRIC ZONE

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1951-41	1,768	4,243	8,102	11,167	16,316	17,879	73,190	191,706	347,109	501,203	925,270	2,097,953
1961	1,768	4,463	7,489	11,149	15,358	18,550	73,930	200,523	322,129	503,170	926,808	2,085,337
						ISLAND OF MONTREAL						
1951-41	1,768	4,243	5,455	8,823	5,995	17,879	29,142	25,619	6,989	1,998	-	107,911
1961	1,768	4,287	5,400	7,973	6,234	17,645	26,991	24,991	15,358	1,997	-	112,644
						CITY OF MONTREAL						
1951-41	1,768	3,889	3,461	7,371	4,554	3,555	6,306	-	-	-	-	30,904
1961	1,768	3,933	3,362	6,521	4,059	5,631	5,212	-	-	-	-	30,486

TABLE NO. 3

POPULATION BY CONCENTRIC ZONE

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1941	84,173	261,894	293,362	293,241	75,383	35,208	88,613	38,438	48,212	71,315	120,420	1,410,259
1951	80,220	248,035	289,981	374,214	155,210	73,556	149,474	63,652	79,689	94,211	144,746	1,752,988
1961	50,664	219,003	282,836	484,430	236,699	214,709	335,321	184,999	166,073	130,318	178,580	2,483,632
						ISLAND OF MONTREAL						
1941	84,173	261,894	285,454	283,959	72,064	35,208	74,308	14,045	2,117	3,561	-	1,116,783
1951	80,220	248,035	277,095	355,550	126,266	73,556	119,581	29,195	5,532	4,220	-	1,319,250
1961	50,664	219,003	262,467	434,739	205,888	208,260	248,169	78,127	30,374	5,306	-	1,742,997
						CITY OF MONTREAL						
1941	84,173	249,904	214,110	243,083	65,028	10,252	36,397	-	-	-	-	902,947
1951	80,220	236,124	208,640	301,882	112,712	19,290	62,652	-	-	-	-	1,021,520
1961	50,664	207,208	194,736	373,526	153,918	90,509	120,501	-	-	-	-	1,191,062

Note: The maximum population of each zone is underlined.

POPULATION BY CONCENTRIC ZONE, AS A PERCENTAGE OF THE TOTAL POPULATION

TABLE NO. 4

Years	1		2		3		4		5		6		7 - 9		10 - 14		15 - 19		20 - 25		Remainder of Inner Region		Total	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
INNER REGION (A: % of zones 0-25; B: % of inner region)																								
1941	6.5	6.0	20.3	18.6	22.8	20.8	22.7	20.8	5.9	5.3	2.7	2.5	6.9	6.3	3.0	2.7	3.7	3.4	5.5	5.1	9.3	8.5	109.3	100.0
1951	5.0	4.6	15.4	14.1	18.0	16.5	23.3	21.3	9.6	8.9	4.6	4.2	9.3	8.5	4.0	3.6	5.0	4.6	5.8	5.4	9.0	8.3	109.0	100.0
1961	2.2	2.0	9.5	8.8	12.3	11.4	21.0	19.5	10.3	9.5	9.3	8.6	14.5	13.5	8.0	7.4	7.2	6.7	5.7	5.3	7.7	7.3	107.7	100.0
ISLAND OF MONTREAL																								
1941	7.5		23.4		25.6		25.4		6.4		3.2		6.7		1.3		0.2		0.3		-		100.0	
1951	6.1		18.8		21.0		26.9		9.6		5.6		9.1		2.2		0.4		0.3		-		100.0	
1961	2.9		12.6		15.1		24.9		11.8		12.0		14.2		4.5		1.7		0.3		-		100.0	
CITY OF MONTREAL																								
1941	9.3		27.7		23.7		26.9		7.2		1.1		4.1		-		-		-		-		100.0	
1951	7.9		23.1		20.4		29.6		11.0		1.9		6.1		-		-		-		-		100.0	
1961	4.3		17.4		16.3		31.4		12.9		7.6		10.1		-		-		-		-		100.0	

Note: The highest percentage in each zone is underlined.

TABLE NO 5

CHANGES IN POPULATION BY CONCENTRIC ZONE

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1941-51	-3,953	-13,859	-3,381	+80,973	+79,827	+38,348	+60,861	+25,214	+31,477	+22,896	+24,326	+342,729
1951-61	-29,556	-29,032	-7,145	+110,216	+81,489	+141,153	+185,847	+121,347	+86,384	+36,107	+33,834	+730,644
1941-61	-33,509	-42,891	-10,526	+191,189	+161,316	+179,501	+246,708	+146,561	+117,861	+59,003	+58,160	+1,073,373
						ISLAND OF MONTREAL						
1941-51	-3,953	-13,859	-8,359	+71,591	+54,202	+38,348	+45,273	+15,150	+3,415	+659	-	+202,467
1951-61	-29,556	-29,032	-14,628	+79,189	+79,622	+134,704	+128,588	+48,932	+24,842	+1,086	-	+423,747
1941-61	-33,509	-42,891	-22,987	+150,780	+133,824	+173,052	+173,861	+64,082	+28,257	+1,745	-	+626,214
						CITY OF MONTREAL						
1941-51	-3,953	-13,780	-5,470	+58,799	+47,684	+9,038	+28,255	-	-	-	-	+120,573
1951-61	-29,556	-28,916	-13,904	+71,644	+41,206	+71,219	+57,652	-	-	-	-	+169,345
1941-61	-33,509	-42,696	-19,374	+130,443	+88,890	+80,257	+85,907	-	-	-	-	+289,918

CUMULATED PERCENTAGES, BY CONCENTRIC ZONE, OF POPULATION EXPRESSED AS A PERCENTAGE OF THE TOTAL POPULATION

TABLE NO 6

Years	1		2		3		4		5		6		7 - 9		10 - 14		15 - 19		20 - 25	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
INNER REGION (A: % of zones 0-25; B: % of inner region)																				
1941	6.5	6.0	26.8	24.6	49.6	45.4	72.3	66.3	78.2	71.5	80.9	74.0	87.8	80.3	90.8	83.0	94.5	86.4	100.0	91.5
1951	5.0	4.6	20.4	18.7	38.4	35.2	61.7	56.5	71.3	65.4	75.9	69.6	85.2	78.1	89.2	81.7	94.2	86.3	100.0	91.7
1961	2.2	2.0	11.7	10.8	24.0	22.2	45.0	41.7	55.3	51.2	64.6	59.8	79.1	73.3	87.1	80.7	94.3	87.4	100.0	92.7
ISLAND OF MONTREAL																				
1941	7.5		30.9		56.5		81.9		88.3		91.5		98.2		99.5		99.7		100.0	
1951	6.1		24.9		45.9		72.8		82.4		88.0		97.1		99.3		99.7		100.0	
1961	2.9		15.5		30.6		55.5		67.3		79.3		93.5		98.0		99.7		100.0	
CITY OF MONTREAL																				
1941	9.3		37.0		60.7		87.6		94.8		95.9		100.0		-		-		-	
1951	7.9		31.0		51.4		81.0		92.0		93.9		100.0		-		-		-	
1961	4.3		21.7		38.0		69.4		82.3		89.9		100.0		-		-		-	

TABLE NO 7

PERCENT CHANGE IN POPULATION BY CONCENTRIC ZONE

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1941-51	-4.7	-5.3	-1.2	+27.6	+105.9	+108.9	+68.7	+65.6	+65.3	+32.1	+20.2	+24.3
1951-61	-36.8	-11.7	-2.5	+29.5	+52.5	+191.9	+124.3	+190.6	+108.4	+38.3	+23.4	+41.7
						ISLAND OF MONTREAL						
1941-51	-4.7	-5.3	-2.9	+25.2	+75.2	+108.9	+60.9	+107.9	+21.2	+35.6	-	+18.1
1951-61	-36.8	-11.7	-5.3	+22.3	+63.1	+183.1	+107.5	+167.6	+449.1	+25.7	-	+32.1
						CITY OF MONTREAL						
1941-51	-4.7	-5.5	-2.6	+24.2	+73.3	+88.2	+72.1	-	-	-	-	+13.1
1951-61	-36.8	-12.2	-6.7	+23.7	+36.6	+369.2	+92.0	-	-	-	-	+16.6

TABLE NO 8

GROSS DENSITY BY CONCENTRIC ZONE

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1941	47.6	61.7	36.2	26.3	4.6	2.0	1.2	0.2	0.13	0.14	0.13	0.67
1951	45.4	58.5	35.8	33.5	9.5	4.1	2.0	0.33	0.22	0.19	0.16	0.84
1961	28.6	51.0	37.8	43.4	15.4	11.6	4.5	0.92	0.51	0.26	0.19	1.19
						ISLAND OF MONTREAL						
1941	47.6	61.7	52.3	32.2	12.0	2.0	2.5	0.5	0.3	1.8	-	10.3
1951	45.4	58.5	50.8	40.3	21.1	4.1	4.1	1.1	0.8	2.1	-	12.2
1961	28.6	51.1	48.6	54.5	33.0	11.8	9.2	3.2	2.0	2.7	-	15.6
						CITY OF MONTREAL						
1941	47.6	64.3	61.9	33.0	14.3	2.9	5.8	-	-	-	-	29.2
1951	45.4	60.7	60.3	41.0	24.7	5.4	9.9	-	-	-	-	33.1
1961	28.6	52.7	57.9	57.3	37.9	16.1	23.1	-	-	-	-	39.1

DENSITY, BY CONCENTRIC ZONE, AS A PERCENTAGE OF THE AVERAGE DENSITY

TABLE NO 9

Years	1	2	3	4	5	6	7 - 9	10 - 14	15 - 19	20 - 25	Remainder of Inner Region	Total
						INNER REGION						
1941	7,104.5	9,209.0	5,403.0	3,925.4	686.5	298.5	179.1	29.9	19.4	20.9	19.4	100.0
1951	5,404.8	6,964.3	4,261.9	3,988.1	1,131.0	488.1	238.1	39.3	26.2	22.6	19.0	100.0
1961	2,403.4	4,285.7	3,176.5	3,647.1	1,294.1	974.8	378.1	77.3	42.9	21.8	16.0	100.0
						ISLAND OF MONTREAL						
1941	462.1	599.0	507.8	312.6	116.5	194.0	24.3	4.9	2.9	17.5	-	100.0
1951	372.1	479.5	416.4	330.3	173.0	33.6	33.6	9.0	6.6	17.2	-	100.0
1961	183.3	327.6	311.5	349.4	211.5	75.6	59.0	20.5	12.8	17.3	-	100.0
						CITY OF MONTREAL						
1941	163.0	220.2	212.0	113.0	49.0	9.9	19.9	-	-	-	-	100.0
1951	137.2	183.4	182.2	123.9	74.6	16.3	29.9	-	-	-	-	100.0
1961	73.1	134.4	148.1	146.5	96.9	41.2	59.1	-	-	-	-	100.0

CHART NO. 1

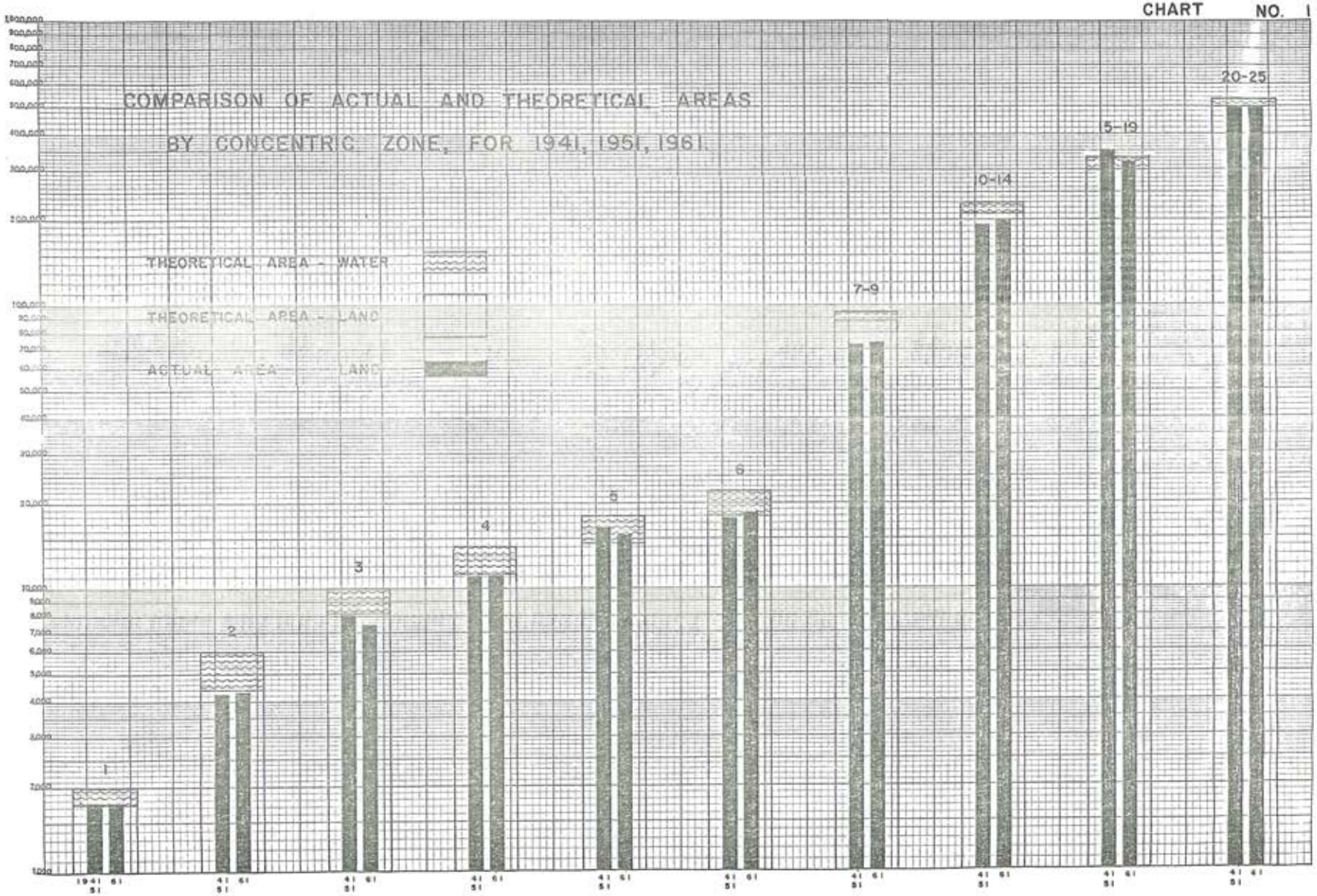
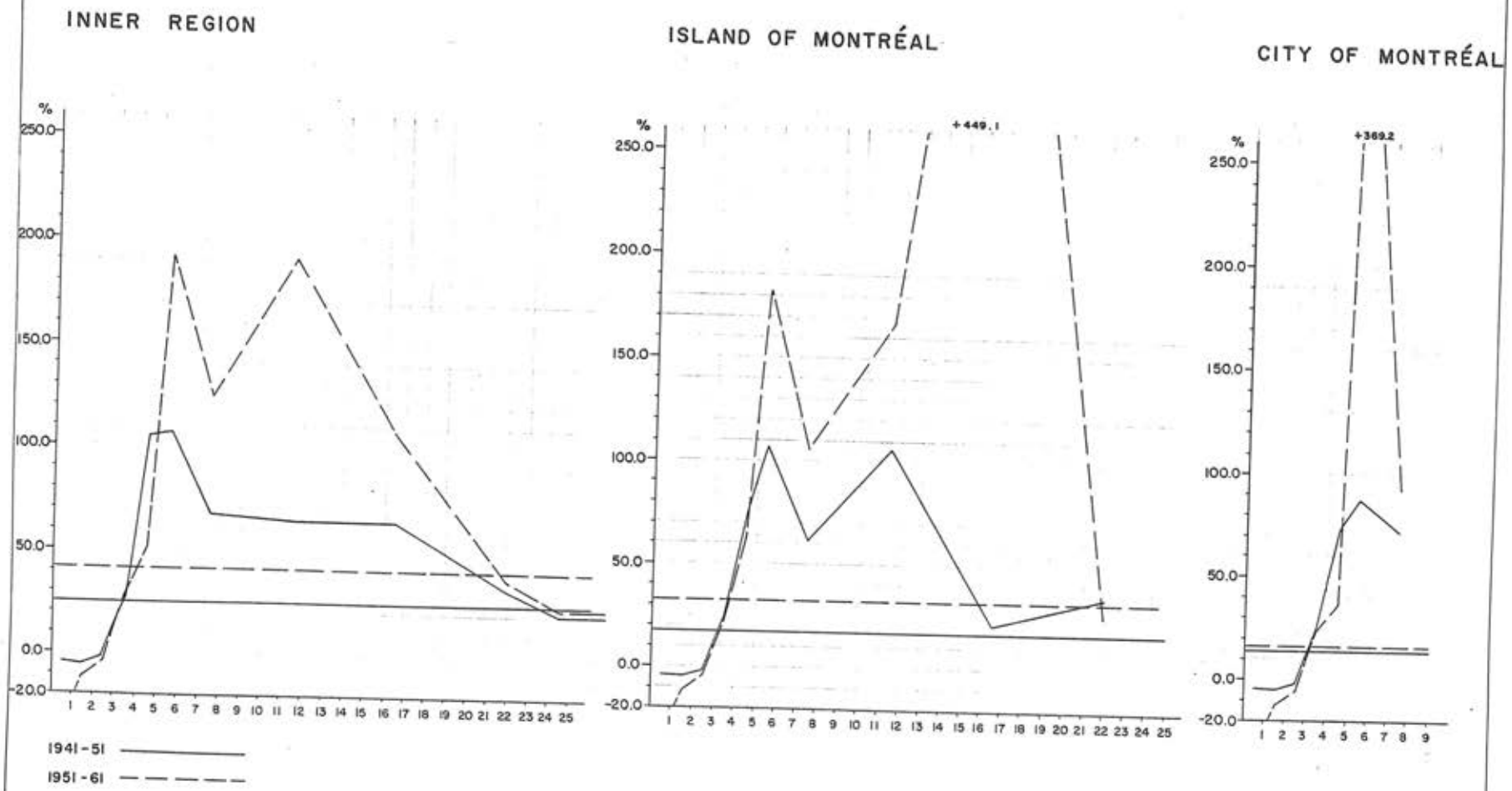


CHART NO. 2

PERCENT CHANGE IN POPULATION BY CONCENTRIC ZONE

1941 - 51 AND 1951 - 61



NOTE: *THE HORIZONTAL LINES SHOW THE AVERAGE PERCENT CHANGE IN EACH DECADE.*

CHART NO. 3

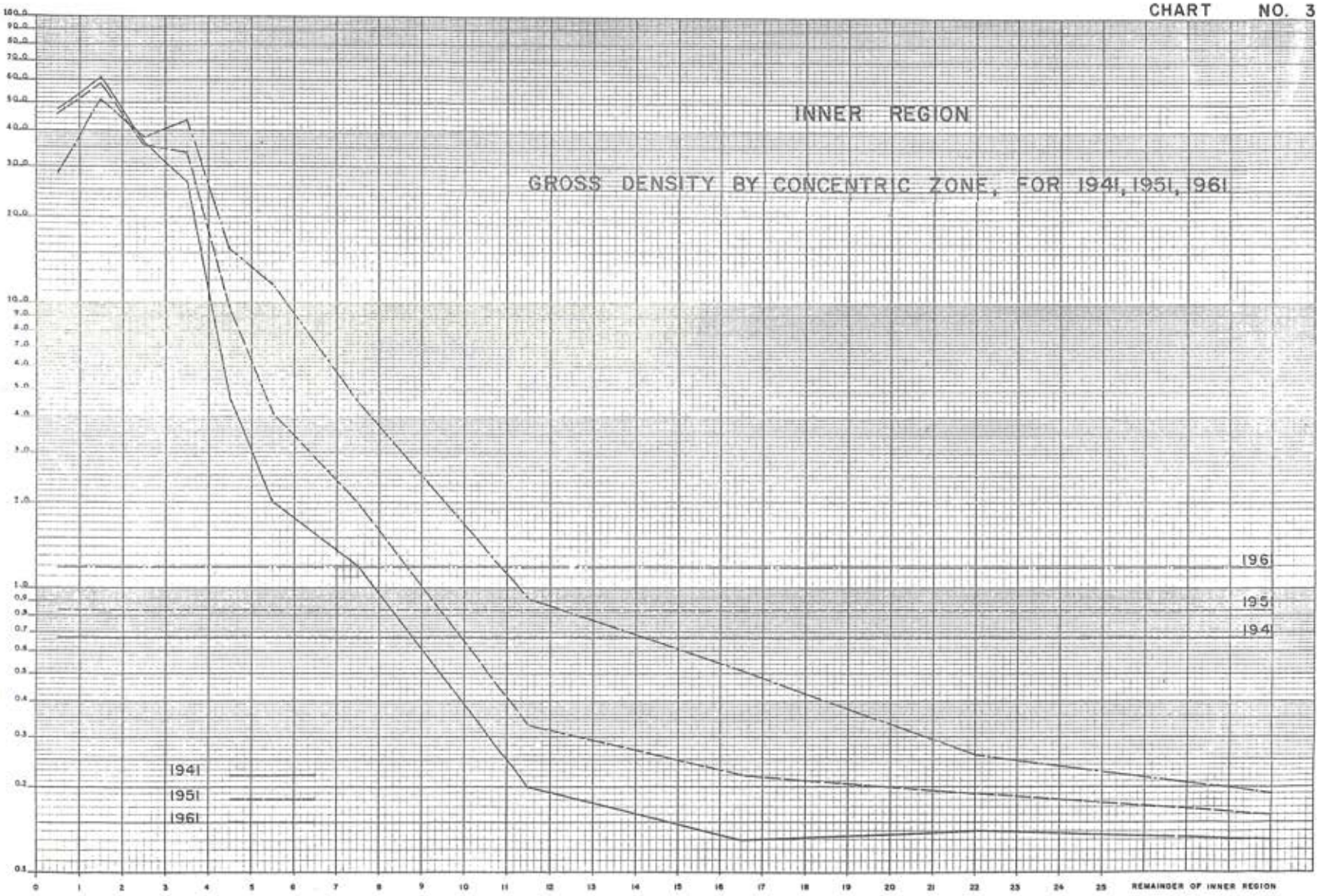


CHART NO. 4

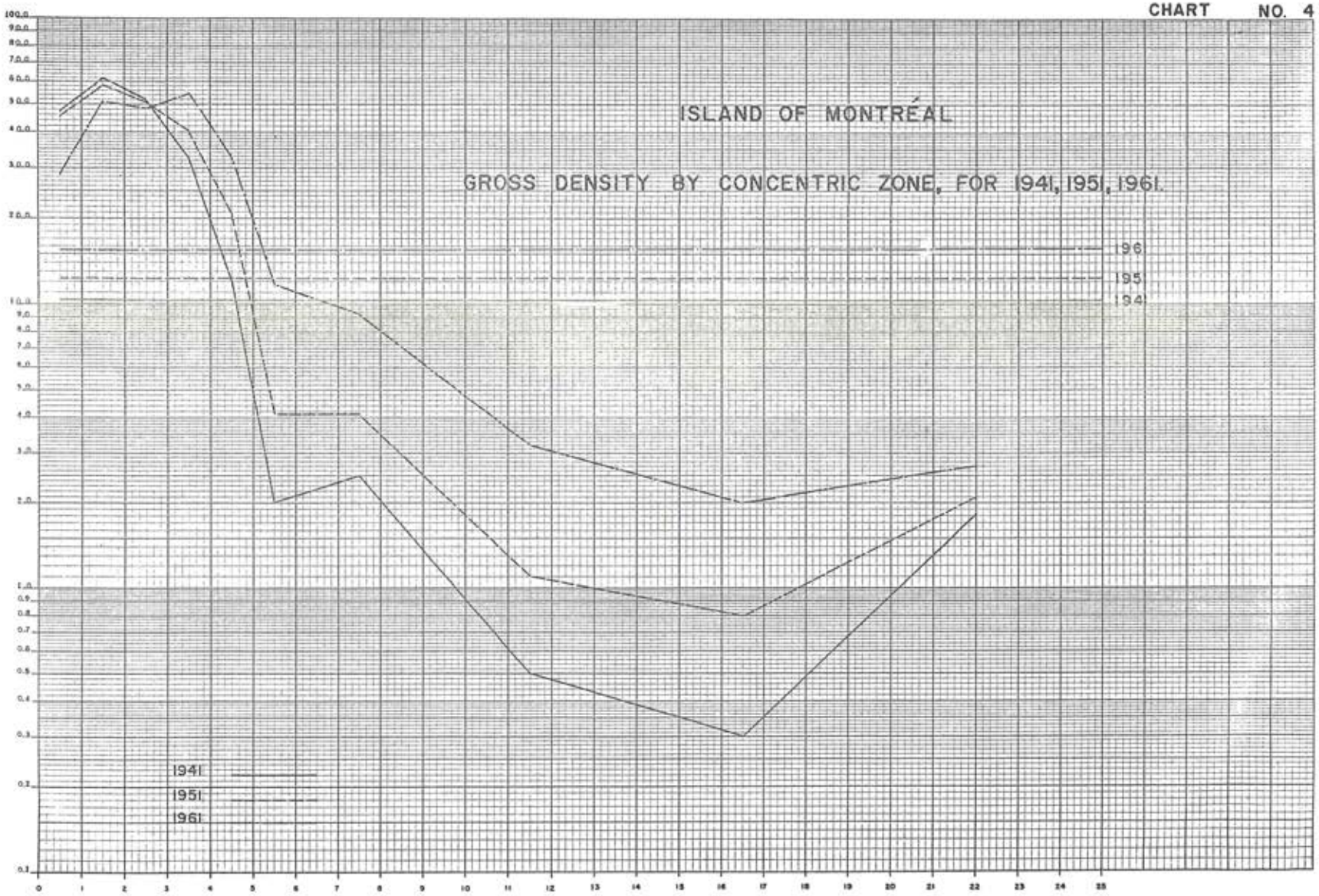


CHART NO. 5

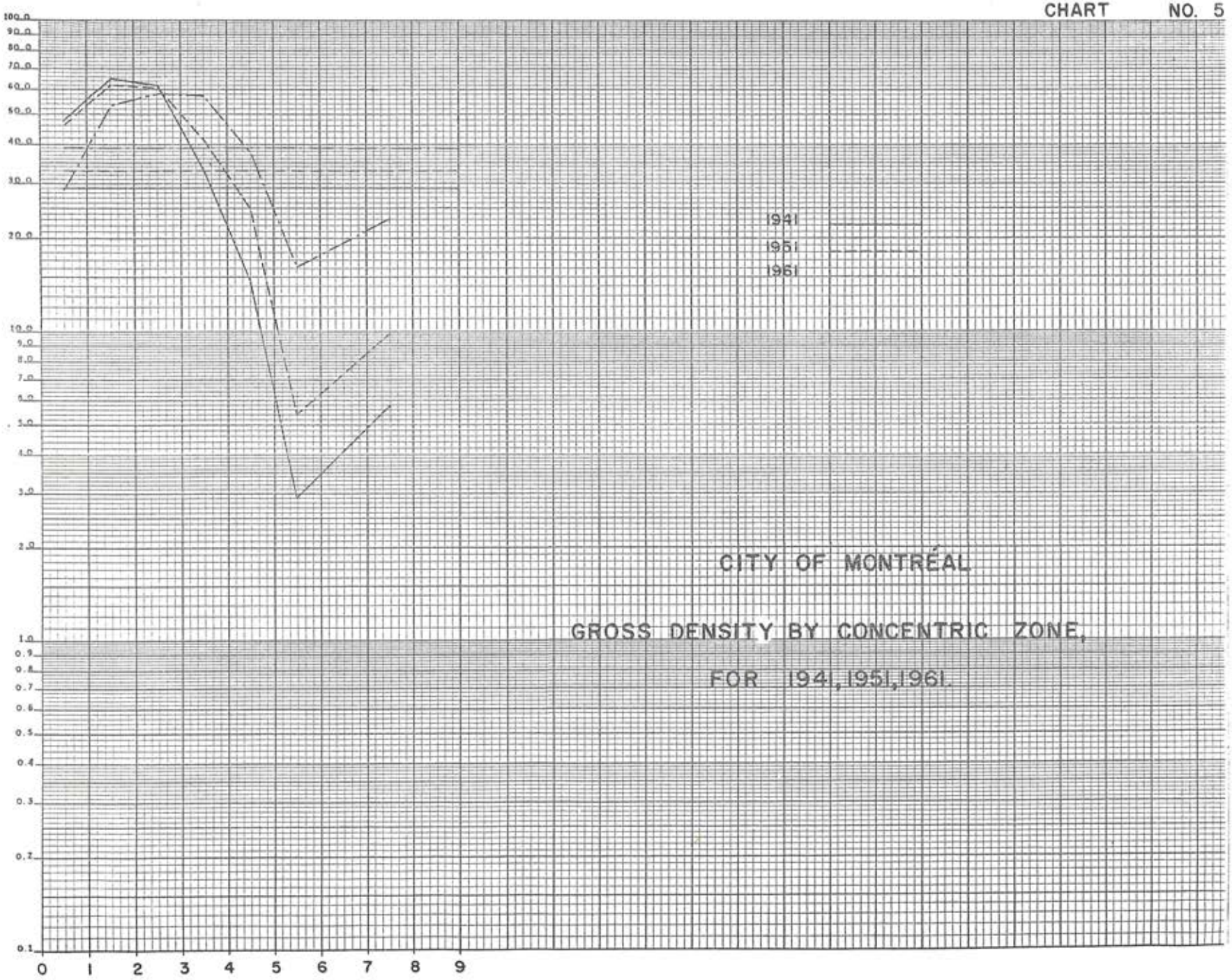
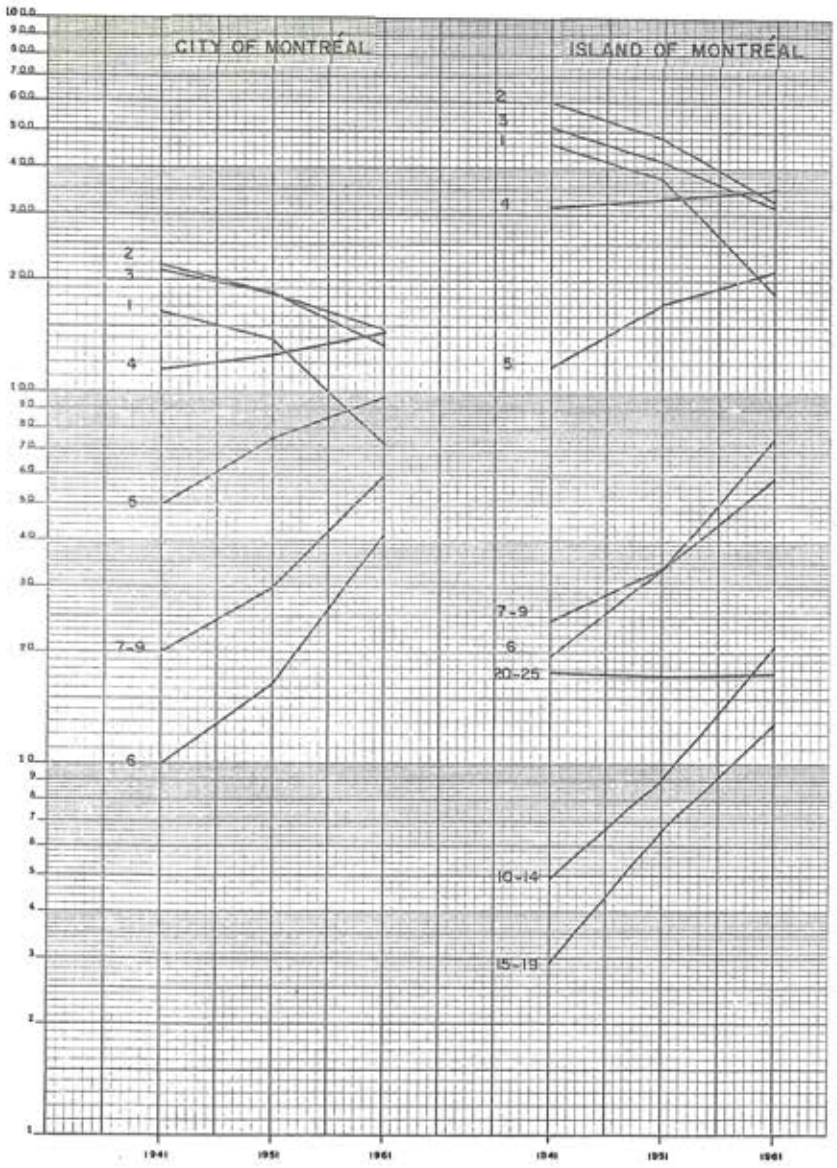
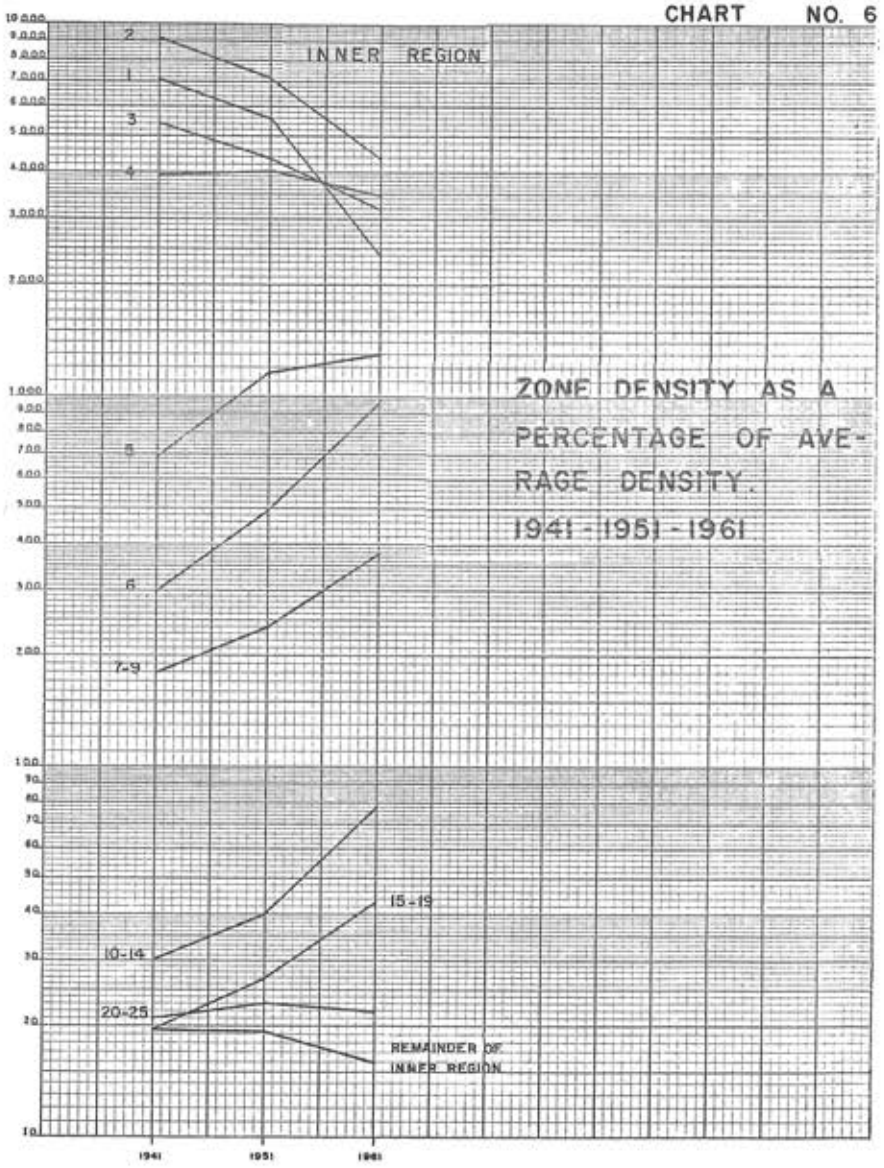


CHART NO. 6





ZONE DENSITY AS A PERCENTAGE OF AVERAGE DENSITY. 1941 - 1951 - 1961

Notes

(1) Hans Blumenfeld, "On the Concentric Circle Theory of Urban Growth," Land Economics, Madison, Wisconsin, May 1949.
Hans Blumenfeld, "The Tidal Wave of Metropolitan Expansion," AIP Journal, Vol. XX, No. 1.

(2) Ernest W. Burgess, "The Growth of the City," in The City R. E. Park et al. (eds.), University of Chicago Press, 1925.
Homer Hoyt, "The Structure and Growth of Residential Neighborhoods" in American Cities, Federal Housing Administration, 1939.
Hans Blumenfeld, "Are Land Use Patterns Predictable," AIP Journal, Vol. XXV, No. 2: May 1959.

(3) See Map No. 2. This map compares two series of concentric zones: one whose center is located at the intersection of Craig & McGill Streets and the other whose center is the City Hall. In this case, there is a displacement towards the west - on an east-west axis - of some three tenths of a mile.

(4) Métropole: Les Cahiers d'urbanisme, No. 1, January 1963. Published by the City Planning Department of the City of Montreal.

(5) The spread between practical area and theoretical area, as well as the differences from one decade to the next, are not too great. For nearly all concentric zones the spread is within ± 10%. For the total of all concentric zones the spread was only 2.2% for 1941-51 and 1.0% for 1961.

(6) See Table No. 2 which indicates, by concentric zone, the area in acres of the inner region, the Island, and the City of Montreal.

(7) Métropole: Les Cahiers d'urbanisme, No. 1, January 1963, pp. 17 to 23. Published by the Montreal City Planning Department.

(8) See Table No. 2.

(9) These data can be compared with those of the Technical Division of the Public Works Department, published in the annual reports of the Assessment Department:

Years	Technical Division	Planning Department
1941	32,254.07 acres	30,905.1 acres
1951	32,256.61 acres	30,905.1 acres
1961	32,458.45 acres	30,486.0 acres

The difference is of the order of 1,500 to 2,000 acres. If it is remembered that the calculation of areas made by the Technical Division is based on ward areas while those carried out by the Planning Department are based on census tracts, it can be concluded that the difference is negligible.

It will be noted that there are differences between the 1951-41 and 1961 areas, when in fact these should be identical. These differences, or at least a good part of them, are due to changes in municipal and census tract boundaries. In certain cases, between 1951 and 1961, municipalities extended beyond the concentric zones to which they had previously been assigned. The limits of the inner region did not change: no municipality could extend beyond the inner region. Nevertheless, a minimal difference of 0.6% is to be noted between the total areas given for the inner region in 1951-41 and that of 1961.

(10) See Table No. 3: inner region; Island of Montreal; City of Montreal.

(11) See Table No. 4.

(12) See Table No. 5: "Changes in population (in absolute figures) for the decades 1941-51 and 1951-61":

inner region (zones 1, 2 et 3)	- 86,926
Island of Montreal (zones 1, 2 et 3)	- 99,387
City of Montreal (zones 1, 2 et 3)	- 95,579

(13) See Table No. 6.

(14) The Planning Department is currently preparing a "Preliminary Study of Downtown Montreal." Being studied, among other things, are the changes in floor space of the various functions between 1949 and 1962. The area of the downtown study corresponds closely to the first concentric zone. The downtown study area is bounded by Guy Street, Pine Avenue, St. Denis Street, the Lachine Canal and the river. The following changes were noted: (loss or gain in floor space) -

Residence:	- 2,139,800
Industry:	- 746,100
Retail Trade:	- 573,200
Offices:	+ 9,155,100
Hotels & miscellaneous:	+ 1,521,400
Institutions:	+ 1,468,300
Public Properties:	+ 896,200

Residences, industry, and retail shopping are replaced by offices, hotels, institutions and public properties.

(21) See Table No. 8 and Charts Nos. 2, 3 and 5.

(22) See Charts Nos. 2, 3, and 5.

(23) See Table No. 9 and Chart No. 6.

(15) See Table No. 4.

(16) See Tahle No. 7 and also Chart No. 2.

(17) See Table No. 7 and chart No. 2.

(18) This is apparent on Chart No. 2.

(19) See Chart No. 2.

(20) See Charts Nos. 2, 3 and 5.

Toute demande pour des copies supplémentaires de ce bulletin doit être adressée à:

SERVICE D'URBANISME,

107 ouest, rue Saint-Jacques,
Ville de Montréal.

Texte et compilation:

Robert Robert, M.R.P.

Cartes, graphiques et dessin de la page couverture:

Robert Ronchard
Marcel Garneau
Gilbert Bureau
René Trudelle

Responsables de la publication:

H. N. Lash
Guy Gravel