EMPIRICAL ANALYSIS OF BUSINESS
LOCATION IN GREATER VANCOUVER

by

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ABSTRACT

This thesis represents an empirical analysis of business
location in Greater Vancouver based upon the analysis of the returns
to a location survey questionnaire. This questionnaire comprises
a portion of the IIPS project which is a large-scale, special re-
search study of the Region. The study empirically determines which
questionnaire variables (factors) influence the relative location/
relocation of various firms located in the G.V.R.D. Statistical
analysis and regression models provide an empirical data base for
the land use group in their development of models which allocate
economic activities across the Region.

The questionnaire returns possess limitations with respect to
both scope of coverage and questionnaire format. Analysis is accord-
ingly limited; suggestions are made to obtain better quality empirical
data in future studies.

The thesis derives some general interregional results although
the data is extensively utilized in a decidedly intrametropolitan
context. The interregional results depict which variables are im-
portant in the location and relocation decisions for each subpopulation.
In contrast, an empirical basis for intrametropolitan business loc-
ation policy in the G.V.R.D. is derived from the analysis herein.
The intrametropolitan analysis is feasible because size (i.e. number
of employees) and location are known for most respondents. An empir-
ical synthesis via some common independent variables is suggested

to exist, at least for the G.V.R.D., between interregional and intrametropolitan location. This will aid in the construction of future questionnaire studies for each subpopulation at the interregional or intrametropolitan levels in the G.V.R.D. Eventually, location theories of substantial empirical utility will be derived for each subpopulation.

Aside from the empirical value, this thesis is valuable in terms of analytical procedure. The regression transformation technique is applicable to other questionnaire studies where the type of response scale constructed is in question.

The overview of location theory and Metropolitan Vancouver are furthermore thought to provide an appropriate background to this study as well as represent a substantial literary contribution.

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The final product of the research and practical study as represented in this thesis is entirely my own, and I therefore remain solely responsible for any errors or omissions.

CHAPTER I

INTRODUCTION

A. Justification for the Study

This thesis is related to another thesis entitled The Analysis
of Manufacturing Location in Greater Vancouver by G. M. Richmond.[1]
Although the same location survey questionnaire is used in both
studies, the present study differs in two major respects:

1.   This study considers the major industry subpopulations,

        i.e. retail, wholesale, financial, etc., rather than just

        the manufacturing population.

2.   This study utilizes the data in a decidedly intrametropolitan

        context, given that some general interregional results

        are derived.

The interregional results depict which variables are important

in the location and relocation decisions for each subpopulation. The

similarity of response between these two decisions is determined

with Spearman rank correlation coefficients. The intrametropolitan

approach, in contrast to these results, is recommended by Richmond:

> "...it would be worthwhile to incorporate the spatial
> element into an expanded analysis of the location survey
> questionnaire returns. The...analysis of the intra-
> metropolitan spatial pattern of response...(is motivated
> by)...spatially oriented studies of location within urban
> areas (Goldberg, 1969). Such studies suggest that it
> would be worthwhile to analyze variation in location
> factor preferences between central city and suburban
> operations. The location requirements and policy implic-
> ations regarding the accommodation of ...(subpopulations)
> ...in these two areas of the city...(may) possess

> distinct differences...Knowledge of the patterns...
> in this regard would be of relevance to the formu-
> lation of...zoning schemes to accommodate various
> types and sizes of...(business)...activities within
> the metropolitan area."[2]

Consideration of location factors provides a logical basis for, and avoids a maldistribution of, the location of subpopulations. Although it is beyond the scope of this thesis to develop intertemporal questionnaire data, analysis of such data is recommended to approp- riately study locational dynamics. Proper location further avoids losses which would otherwise accrue to entrepreneurs and the city as a whole under a system of locational inefficiency. Therefore, an empirical basis for intrametropolitan location policy in the G.V.R.D. is derived from the analysis herein.

Aside from the empirical value, this thesis is also of value in terms of methodological and analytical procedure. Modifications of the location survey procedure and format suggested in the text are applicable to business location surveys in general. The regression transformation technique is applicable to other questionnaire studies where the type of response scale constructed is in question.

Furthermore, the overview of location theory and Metropolitan Vancouver are thought to provide an appropriate background to this study as well as represent a substantial literary contribution.

B. Objectives and Limitations of the Study

This study empirically determines which questionnaire vari- ables (factors) influence the relative location/relocation of various firms located in the G.V.R.D. The location survey questionnaire comprises a portion of the IIPS project which is a large-scale, special research study of the G.V.R.D. The location survey question-

naire was to be used in conjunction with the Input-Output question-
naire. The location survey questionnaire measures the level of
importance of nineteen factors in a firm's actual decision to locate
in the G.V.R.D., as well as a firm's hypothetical decision to
relocate outside the G.V.R.D. The Input-Output questionnaire re-
quests precise revenue/sales and expenditure by spatial sector in
order to construct an input-output matrix. The SIC number, sector,
number of employees, and street address are known for both question-
naires. Thus, wide scope for statistical analysis is possible with
both questionnaires.

Meagre response was unfortunately received for the Input-Output
questionnaire. Presumably, firms were reluctant to divulge extremely
confidential information for the public good. Thus, the location
survey questionnaire is presently of limited utility to the economics
group.

The land use group, however, will find the location survey
questionnaire results useful. This group is developing models to
allocate economic and residential activities across the Region.
Emphasis is upon the development of rigorous housing models to assess
the impact of all levels of government policies on the supply and
demand for regional housing. However, the statistical analysis and
regression models of the present location survey questionnaire study,
provide an empirical data base for the land use group in their develop-
ment of models which allocate economic activities across the Region.

The empirical data base for this thesis consists of 300 usable
returns of the location survey questionnaire received by February 1972.
Approximately 20 responses were unusable due to insufficient inform-
ation with respect to answering the questionnaire, sector number or

location. This represents a total usable response rate of 7.9% which is quite poor. Consequently, inferences about the location/ relocation of some subpopulations are constrained by the limited number of cases for these subpopulations.

The usable response rate is further constrained by missing values. Although a few respondents did not reveal the number of employees or attribute importance to a particular factor, several failed to answer either questions 1 or 2 of the location survey questionnaire. 15 failed to answer question 1; 83 failed to answer question 2. Thus complete responses, i.e. answers to both questions 1 and 2, were only received from 202 firms or 67.3 per cent of the total number of firms included in this survey. Given the similar format on both sides of the questionnaire in Figure 4.II and the larger number of null responses to question 2, it appears that several respondents did not realize that there is a question 2.

A major disadvantage of questionnaires in general is that there is always some uncertainty as to whether scores are true or merely represent some degree of perceptional bias.

There are some limitations to the present questionnaire which could be rectified to obtain better data.

1.   This study is severely limited because it is unknown when the decision was made by firms to locate in the G.V.R.D.

2.   It is unknown whether respondents actually intend to move.

3.   Although it is possible to indirectly perform intrametro-politan location analysis, the importance of the location factors at the regional and intrametropolitan levels could be fully established and compared if a supplement to question 1 states, "For each of the following factors would you please indicate the level of importance

in your decision to locate your business in the particular munici-
pality in the Vancouver Region."

4.   More precise definition of the factors is required in future
studies. For example, is the factor "Truck transportation" used in
the context of availability of, cost of, or both? Is the "Availability
of large tracts of land" required for a large plant, onsite expansion,
or both?

From the above, it becomes apparent that the quality, reli-
ability and completeness of the location questionnaire survey is quite
limited for an intrametropolitan location study of the G.V.R.D. Only
through the continual "de-bugging" of this and subsequent question-
naire studies can the questionnaire's utility as an empirical data
base be improved.

C. General Approach of the Study

As suggested above, it is only possible to indirectly perform
intrametropolitan location analysis. Intrametropolitan location is
concerned with choosing a location within an urban area; interregional
location is concerned with choosing a location from among spatially
separate and heterogeneous regions considered to be points in space.
The independent variables of interregional location theory are con-
sidered in the literature to be inapplicable to intrametropolitan
location theory because these variables display little variation over
the relatively homogeneous urban environment.[3] This thesis determines
which factors influence different industry subpopulations to choose
Metropolitan Vancouver as a regional location. Since the intra-
metropolitan firm size (i.e. number of employees) and location are
known for most respondents, this thesis attempts a limited intra-

metropolitan analysis. Thus, only one of the following two hypothesis is operative:

1.   Interregional factors influence a firm's choice of Metropolitan Vancouver as a regional location. These factors are from a mutually exclusive set disjoint from a set of intrametropolitan factors which influence a firm's locational choice within Metropolitan Vancouver.

2.   Interregional factors influence a firm's choice of Metropolitan Vancouver as a regional location. Some of these factors can also influence a firm's locational choice within Metropolitan Vancouver.

If hypothesis 1 is true, then none of the interregional factors would vary significantly with intrametropolitan location. Hypothesis 1 is false because some interregional factors vary with size which in turn varies with intrametropolitan location. Therefore, some interregional factors can also influence a firm's locational choice within Metropolitan Vancouver. More of the questionnaire variables (i.e. interregional factors) typically influence the interregional rather than intrametropolitan location/relocation decisions due to the greater variation of these factors at the interregional level.

An empirical synthesis via some common independent variables is suggested to exist, at least for the G.V.R.D., between interregional and intrametropolitan location. This will aid in the construction of future questionnaire studies for each subpopulation at the interregional or intrametropolitan levels in the G.V.R.D. Further questionnaire studies are however required to establish a stronger comparison between the same set of variables at both location levels.

D. <u>Overview of Interregional Location Theory</u>

   a) Least-cost location theory

   The origin of location theory is attributable to von Thünen.
His theory is applied to the intrametropolitan context in Chapter II
but it is also relevant to the interregional level. von Thünen's
approach is: given the location, determine which product is to be
produced at that location.

   Approximately 75 years later, the Weberian least cost location
theory took an opposite viewpoint: given the product, determine an
interregional location for that product.[4] Greenhut further notes
that,

> "von Thünen assumes a homogeneous land surface and one
> consuming centre; Weber assumes uneven deposits of fuel
> and raw material and several consuming centres, though
> his geometrical representations and general discussions
> are framed in terms of a given buying point."[5]

Weber's theory is based upon a firm's cost minimization of three basic
location factors: transportation cost, labour cost, and agglomerating
forces. Fuel and raw material costs are included in transportation
costs to simplify the analysis. When transfer costs are the only
significant location factor, the least cost transportation site depends
upon the product characteristics. Figure 1.I shows that a "weight
gaining" product such as soft drinks locate near the market to min-
imize transport costs.

Figure 1.I.   "Weight-gaining" process
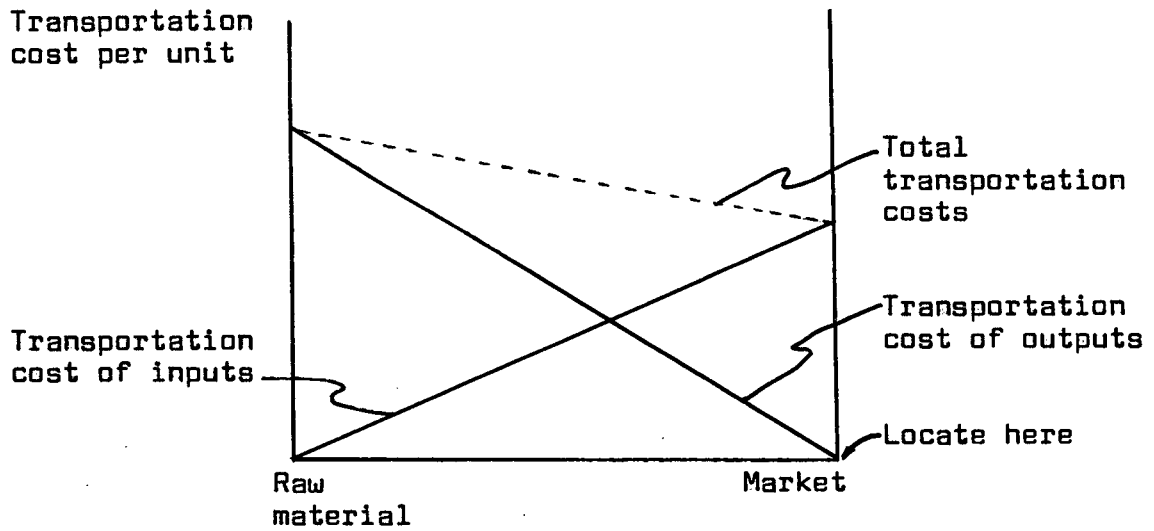
Source: Smith, W.F., "Principles of Urban Development," (Unpublished
          manuscript, 1972), p. 51a.

Alternatively, a product such as iron locates at the source of raw

material, as shown in Figure 1.II, due to the "weight-losing" process.

Figure 1.II.   "Weight-losing" process
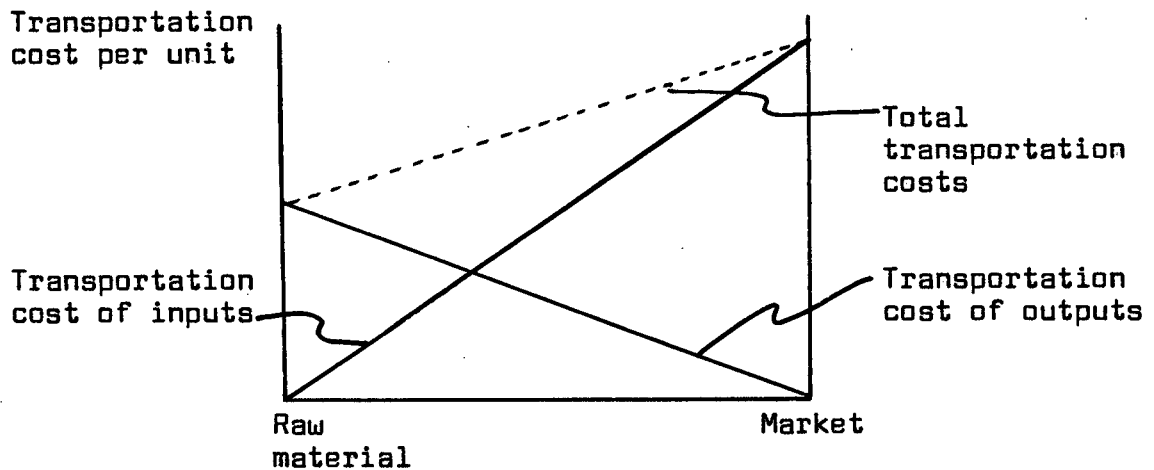
Source: Smith, W.F., "Principles of Urban Development," (Unpublished
          Manuscript, 1972), p. 51a.

Unlike von Thünen, Weber acknowledges the regional variation of labour costs which can offset transfer costs in the location decision of a labour intensive firm. Agglomerating or deglomerating forces respectively intensify or counteract the relationship between transportation and labour costs. Agglomeration typically exists when labour constitutes a significant portion of value added in the production process because such firms can reduce costs by agglomerating. In general, agglomerating advantages, i.e. proximity to auxiliary industries, better marketing outlets, or economics of size, influence the location decision whenever transportation and labour differentials are slight at alternative sites.[6]

Weber excludes institutional and demand factors, i.e. interest, insurance, taxes, climate and management, and only accepts forces which are independent of specific economic systems. Items such as gas, water mains and streets are included as locational factors.[7]

Substitution between transport and non-transport cost factors is possible. Weber's isodapane concept is used to determine the optimum plant location when there exist spatially distinct transport and labour cost optima. It is evident that multiple inputs or markets can accordingly influence the location of firms at the least cost point somewhere in the Weberian polygon.[8]

Hoover, also a least-cost theorist, differs from Weber in approach rather than theory. Location cost factors are functionally separated as either transportation or production factors; demand determinants are mentioned.[9]

Transportation costs include the costs of procuring raw materials and distributing finished products, as well as the costs associated with holding large inventories and customer dissatisfaction due

to distance and slow service. The characteristics of freight costs are of greater concern to Hoover than Weber. Transfer costs do not increase proportionately with distance due to the recognition of fixed terminal costs which vary by transport mode. Therefore, the higher terminal cost, the greater is the economy in a long distance shipment.[10]

Hoover further provides a more comprehensive analysis of the agglomerating and deglomerating forces as well as institutional cost factors; all of which comprise partial determinants of production costs. Better transfer services, a broader more flexible labour market, more advanced banking facilities, better public services, and lower insurance and utility rates constitute agglomeration. Inclusion of institutional factors gives Hoover's analysis a capitalistic context. Hoover's analysis considers all possible locating factors rather than only general factors applicable to all plant locations.[11] Therefore, Hoover adopts Weber's theory to be applied to existing situations.[12] The greatest weakness of Hoover's work is the exclusion of locational interdependence (demand) to justify a location. Rather, the location is assumed; market and supply areas are accordingly derived.[13]

b) Market area analysis

Unlike the least-cost theorists who assume location under perfect competition, market area analysis assumes location with scattered buyers whose sellers function under some form of imperfect competition. Consequently, sellers locate to control different groups of buyers whose demand curve is not horizontal at each location. The size and shape of a firm's market area is accordingly derived.[14]

Goldberg mentions two basic assumptions which underlie market area analysis:

"1. Prices are f.o.b. mill prices (i.e. quoted at
     the factory door.

2. Transportation costs are assumed proportional
    to distance (there are no quantity discounts on
    tonnage or distance, and there are no discon-
    tinuities such as occur at transfer points)."[15]

From the above, it is evident that the market area analysts

neglect costs while least cost theorists neglect demand in their

theories. Attempts to synthesize these two theories are made by

Hoover, a least cost theorist, and Lösch, a market area analyst.

Hoover emphasizes costs and only considers demand with respect to

market area size, shape and number of producers. Lösch does not

emphasize costs but expands the market area theory with the definition

of the firm's minimum size market area and the overview of industrial

agglomeration.[16] Lösch's theory is interregional yet it is further

outlined in Chapter II to provide a basis for central place theory

which is applicable to the intrametropolitan context. Isard, who is

primarily concerned with international trade, does however provide a

synthesis of the Weberian and market area analysis.[17]

    c) Locational interdependence

In contrast to the market area approach which assumes fixed

locations and essentially analyzes short-run phenomenon, the locational

interdependence theorists hypothesize either movable locations (without

cost) or planned future locations in order to find reasons for a

particular location. Locational interdependence considers long-run

equilibrium analysis in the market area context.[18] The following

example illustrates this theory.

A linear market is assumed for simplicity in Figure 1.III;

size, shape and market area are essentially ignored.

Figure 1.III. Spatial competition

```
|_____|
          A——————————•BB'◄—————————A'
```

An infinitely inelastic demand for the product causes two competing

firms to concentrate at the mid-point BB' of the entire market area

rather than to disperse to A,A'.   Infinitely inelastic demand pre-

cludes a lessening of sales due to increased transportation costs

at BB'. Therefore, locational interdependence explains concentrations

of similar firms at a few production centres. Conversely, market

area analysis inadequately explains the case where (1) market demand

is concentrated at a point or (2) the market areas of firms are

identical.[19]

        Goldberg further notes reformulations of classical location

theory by Alonso and Churchill. Alonso, for example, introduces

economies of scale and factor substitution. Variable factor prices

cause variable factor proportions over space whence transport cost

minimization does not necessarily coincide with profit maximization.[20]

E. Subsequent Chapter Organization

        The remainder of this thesis consists of five chapters.

Chapter II briefly reviews some of the rather extensive, major theories

which underlie the intrametropolitan location theory of certain firms.

The third chapter presents an historical, economic and business sector

synopsis of Metropolitan Vancouver. This synopsis outlines some

topics which are relevant to the present location/relocation, question-

aire study of firms located in the G.V.R.D.:

- historical development, spatial form and site qualities;

- land jurisdiction and ownership; and

- population and economic development.

Very brief consideration is given to the intrametropolitan location theory of each subpopulation. Chapter IV considers the location survey questionnaire in the context of the IIPS project. Discussion of the questionnaire technique and the specific variables used in the present study are a prelude to the statistical analysis of the questionnaire data in Chapter V. The fifth chapter explains the general method and summarizes the significant analytical results of the location survey questionnaire. Chapter VI provides a summary of conclusions and recommendations with suggestions for further research.

Five appendices are further presented. Appendix I outlines the business sectors in the Vancouver Metropolitan Input-Output Study. Location, size and economic data appear in Appendix II. A brief mathematical Appendix IV is included for the reader's convenience; Appendix III contains data which is pertinent to Chapter V. Appendix V discusses the coding of the data.

F. <u>References</u>

[1]Richmond, G. M., <u>The Analysis of Manufacturing Location in Greater Vancouver</u> (unpublished M.A. Thesis, U.B.C.: 1973).

[2]<u>Ibid</u>., p. 54.

[3]Goldberg, M. A., <u>Intrametropolitan Industrial Location: Plant Size and the Theory of Production</u>, (University of California, Berkeley, 1969), p. 4.

[4]Greenhut, M. L., <u>Plant Location: In Theory and In Practice</u>, (University of North Carolina Press, 1956), pp. 8-9.

[5]<u>Loc. cit</u>.

[6]<u>Ibid</u>., pp. 9-11.

[7]<u>Ibid</u>., pp. 11, 12.

[8]Goldberg, M.A., Op. cit., pp. 30-32.

[9]Greenhut, M. L., Op. cit., p. 17.

[10]<u>Ibid</u>., pp. 17, 18.

[11]<u>Ibid</u>., p. 19.

[12]Goldberg, M.A., Op. cit., p. 33.

[13]Greenhut, M. L., Op. cit., p. 21.

[14]<u>Ibid</u>., p. 23.

[15]Goldberg, M.A., Op. cit., p. 41.

[16]Greenhut, M.L., Op. cit., pp. 34-37.

[17]Goldberg, M.A., Op.cit., pp. 33-34.

[18]Greenhut, M.L., Op. cit., p. 25.

[19]<u>Ibid</u>., pp. 39, 40.

[20]Goldberg, M.A., Op. cit., pp. 35-37.

CHAPTER II

THE THEORETICAL BACKGROUND - A REVIEW OF
THE LOCATION THEORY LITERATURE

A. Introduction

It is difficult to apply a general intrametropolitan location

theory to Canadian cities due to the diverse types of firms located

therein. Friedmann and Alonso suggest that the distribution of human

activities:

> "....result...from the interdependencies that give
> form to economic space. Spatial patterns will change
> with shifts in the structure of demand and of pro-
> duction, in the level of technology, and in the social
> and political organization of the nation."[1]

Since people tend to make different location decisions over time or

in other regions, it is difficult to develop a general theory which

anticipates or even explains their behaviour. Nevertheless, there

are several broad theories which underlie the intrametropolitan

location theory of certain firms.

This chapter is merely a brief review of some of the rather

extensive, major theories which underlie the intrametropolitan location

theory of certain firms. Economic location, central place, ecological

and other theories of urban land use are briefly summarized. The

interested reader will kindly refer to the footnotes for greater

elucidation.

B. Economic Location Theory of Urban Land Use

The foundations of an urban economic location theory are attributable to the agricultural location theory of von Thünen.[2] Utilizing the basic concept of agricultural location, land rent, a theory of urban economic location is derived. The principle feature of this theory, as Nourse[3] suggests, is that the criteria for the rational choice of a location for a firm or residence are given. Residential or business location respectively results from utility or profit maximization.

Ricardo[4] first mentioned the concept of agricultural land rent which is defined as the excess that an individual located at the margin would be willing to pay a person located at the centre for his better land. von Thünen[5] fully developed the rent concept to suggest that, ceteris paribus, intensity of agricultural land use decreases as distance from the central market increases due to the increase of transportation costs. This statement is based upon the following assumptions:

"1. A uniform physical environment;

2. A completely commercial economy in which the farmer was both desirous and capable of maximizing his profit;

3. Only one means of land transportation and that with costs directly proportional to distance; and

4. An area in which both market and hinterland were solely dependent on each other for their existence (the 'isolated state', as Thünen expressed it)."[6]

Upon examining the choice of alternative uses to which they may put their land, landowners alter their particular combination of the factors of production accordingly. The slope of each economic rent function varies with the land in question.[7] Therefore, Figure 2.I shows the

location of different agricultural land uses which might arise under

von Thünen's assumptions.

Figure 2.I Economic Rent and Relative Location of Competing Agricultural
Land Uses.
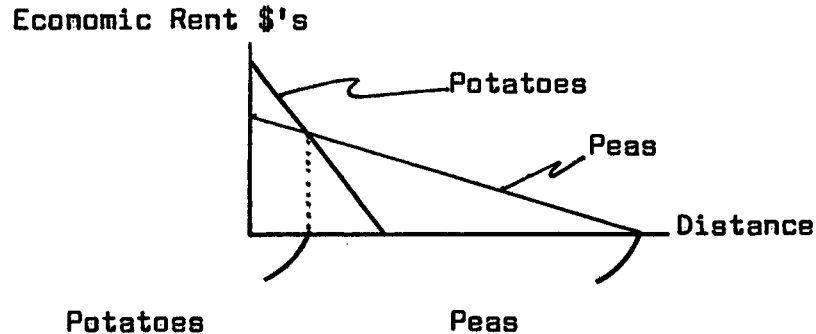
It is possible to transform von Thünen's agricultural location

theory into an urban economic model. Isard suggests that, in the urban

context, bid rent is determined by the following factors:

1. Effective distance from the core.

2. Accessibility of the site to potential customers.

3. Number, nature and locations of competitors.

4. Proximity to land of complementary use or uses which
   both attract customers and minimize costs.[8]

This list is by no means exhaustive; the questionnaire variables, for

example, are further factors which determine bid rent. It is however,

beyond the scope of this study to precisely determine the bid rent

for different categories of firms. Nevertheless, the location and re-

location decisions in the urban economic model are wrought by the

following chain of events:

factors—————➤ bid rent—————➤ relative location

The scope of this study is to empirically determine which questionnaire

variables (factors) influence the relative location/relocation of

various firms located in the G.V.R.D.

From Isard's factors above, it seems intuitive that different

types of firms are influenced by different factors whence relative location. Commercial and service firms, for example, tend to maximize their revenue in a C.B.D. location. The further they locate from the C.B.D., revenue decreases and costs such as advertising increase to offset decreased accessibility. Consequently, the bid rent function of these firms is influenced by the accessibility factor in their location decision. The bid rent function is further influenced by rent per acre which decreases faster with distance from the market centre. The slope of the bid rent function is very steep because advertising costs increase faster than rent per acre decreases with respect to distance. Since net costs increase with distance, greater revenue per square foot of floor space is required. This required revenue becomes increasingly difficult to obtain as land is substituted for non-land inputs. After a certain distance, this breakeven revenue is unobtainable.

A different bid rent function arises for manufacturing firms. Here, total revenues are relatively unchanged but total costs vary spatially for each type of manufacturer. Goldberg demonstrates the tradeoffs which different types of manufacturers make, "between external economies at central locations and internal economies at more distant ones."[9] Since certain manufacturers take advantage of internal economies of scale at peripheral sites, the bid rent function of manufacturing firms is relatively flatter than commercial and service firms.

It is noted that in a mathematical approach towards an urban economic model, Alonso only considers one of Isard's factors as a rent determinant. This is effective distance from the core. Alonso assumes, "a completely centralized city....Other factors, which relate to the interdependence of business locations, are too complex for analysis

here."[10] The concept of a bid price curve, which, "....is a set of combinations of land prices and distances among which the individual is indifferent,"[11] condenses the notions of utility, land, distance, composite goods and money into land cost and money. Consequently, the individual chooses the location, "at which the price structure touches the lowest of the bid price curves with which it comes in contact."[12]

Figure 2.II demonstrates the competitive equilibrium obtained from the bid rent curves determined by various factors associated with the different urban land uses.

Figure 2.II   Economic Rent and Relative Location of Competing Urban Land Uses.

Economic Rent $'s

Commercial and service firms

Manufacturing

Residential

Manufacturing

Agriculture

Distance from market centre

Agriculture

Manufacturing (Peripheral)

Residential

Manufacturing (Central)

Commercial and service firms
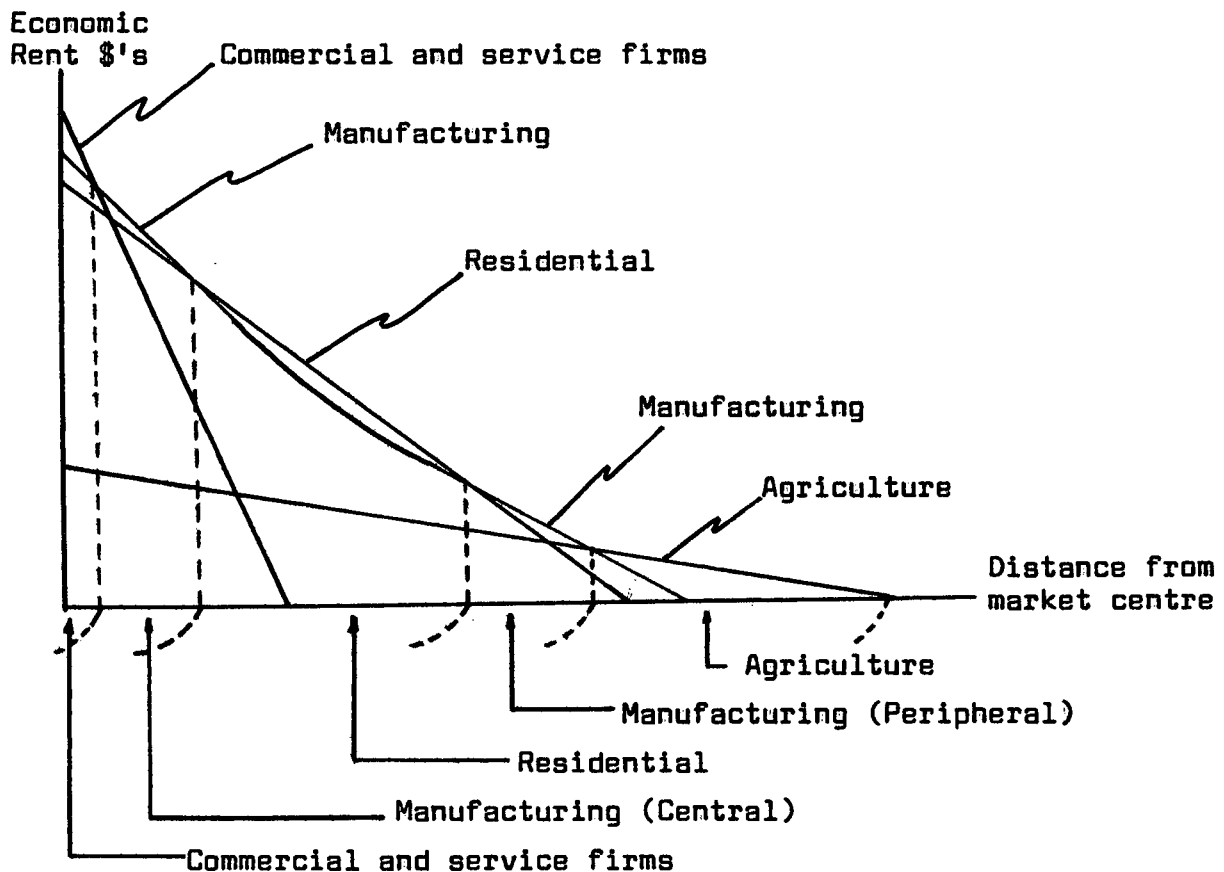
Source: Nourse, H.O., Regional Economics, (New York: McGraw-Hill Book Company, 1968) p. 115.

Therefore, the urban economic model demonstrates the relative location of different urban land uses in aggregate; not at the local level.

C. Central Place Theory

Implicit in the urban economic model is the theory of central place. Berry states that this is the theory of

> "....the location, size, nature and spacing of..... clusters of (economic) activity, and is the theoretical base of much...."[13]

urban analysis. This theory particularly applies to retail and service businesses. It assumes that identical, cost minimizing, uniformly distributed customers can move in any direction over an unbounded plain. In essence, the theory suggests that consumers are basically lazy. For items required most frequently, they travel to the location which requires the least effort to visit. Moreover, consumers postpone less frequent purchases so that only a single trip is required.[14] Berry further states

> "For differing activities centrality therefore has meaning at different scales; in any area a variety of central places will thus exist. Businessmen located in some will attract consumers on a frequent basis, but only over short distances. Other places will be able to provide a greater variety of goods to much wider areas. The clusters of activity in these places vary, along with the sizes of the urban places in which the markets locate."[15]

The bases of central place theory are attributable to Lösch[16] and Christaller.[17] Berry suggests that

> "In Christaller much of the underlying theory is implicit, and it was Lösch who, in an independent derivation, made it explicit. In each case, the theory is developed essentially detached from considerations of the behavior of retailers and consumers over time and in space.
>
> Both theorists agree on the spatial arrangement of stores required for optimal distribution of a single good to a dispersed population. However, their arguments diverge

significantly when they seek to obtain locations for
many kinds of goods considered simultaneously, with
results that make Lösch's "economic landscapes" more
relevant to secondary production at its later market-
oriented stages, and Christaller's hierarchies most
appropriate in analysis of retail and service business
in the tertiary sector."[18]

Lösch's[19] analytic approach, based on Chamberlin's economic

theory, assumes a triangular distribution of nucleated agricultural

villages. Producer's location is conceived as one type of product

differentiation. Figure 2.III demonstrates that the consumer price

for good x increases linearly with respect to distance when transport

costs, mt, are linear.

Figure 2.III   Consumer price/distance relationship
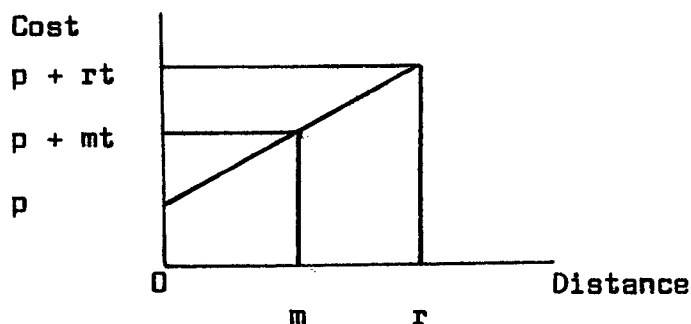
Source: Berry, B.J.L., Geography of Market Centers and Retail
          Distribution, (Prentice-Hall, Inc., Englewood Cliffs,
          N.J., 1967) p. 60.

The price that a consumer pays for good x if he is located at m is

p + mt where m is the number of miles and t is the transport cost per

mile. Since all consumers are assumed to have equal demand for good x,

Figure 2.IV shows that the quantity, q_i, consumed depends on the con-

sumers's price at his particular residence.

Figure 2.IV. Consumer price/quantity relationship
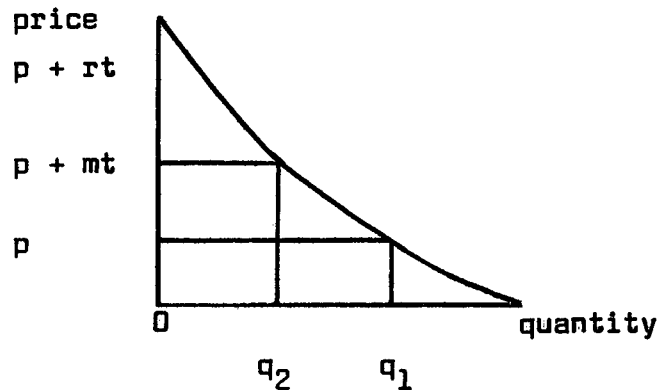
Source: Berry, B.J.L., Geography of Market Centers and Retail
          Distribution, (Prentice-Hall, Inc., Englewood Cliffs,
          N.J., 1967) p. 60.

The demand cone in Figure 2.V is derivable from Figures 2.III-IV.

Figure 2.V. The spatial demand cone
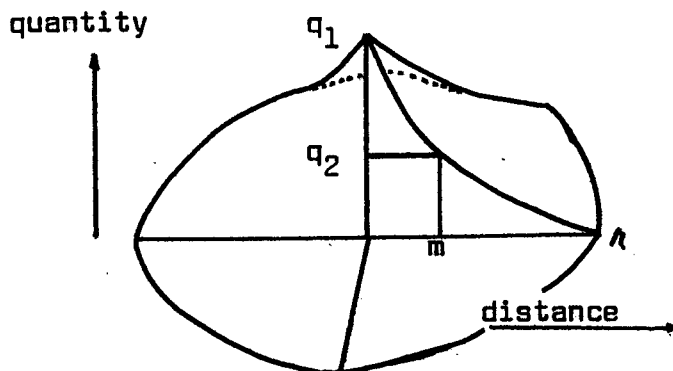
Source: Berry, B.J.L., Geography of Market Centers and Retail
          Distribution, (Prentice-Hall, Inc., Englewood Cliffs,
          N.J., 1967) p. 61.

Quantity consumed decreases with distance due to higher transport

costs. The area D beneath the demand cone represents the total quantity

of good x consumed by customers which live no further than r miles from

the store.[20] Berry states that:

>   "Since quantity demanded, q, varies in response to level
>   of retail price plus transport cost, p + mt, D is found

by integrating the function q = f(p + mt) out to the
maximum radius r, and multiplying by population
density S.

$$Di = S \int_0^{2\pi} \left[\int_0^{m=r} f(p_i + mt)mdm \right] d\theta \qquad (Eq.2.1)$$

If this calculation is repeated for a variety of
different store selling prices, p_i, cones of
varying heights and maximum radii will result, and
different levels of total demand D_i may be calculated.
If these values of p_i and D_i are plotted in a graph
and a line is fitted to the results, an aggregate
demand curve D for the market area can be drawn."[21]

Figure 2.VI shows that a firm can still remain viable with its size

reduced from XY to X^1Y^1.

Figure 2.VI. Aggregate supply and demand
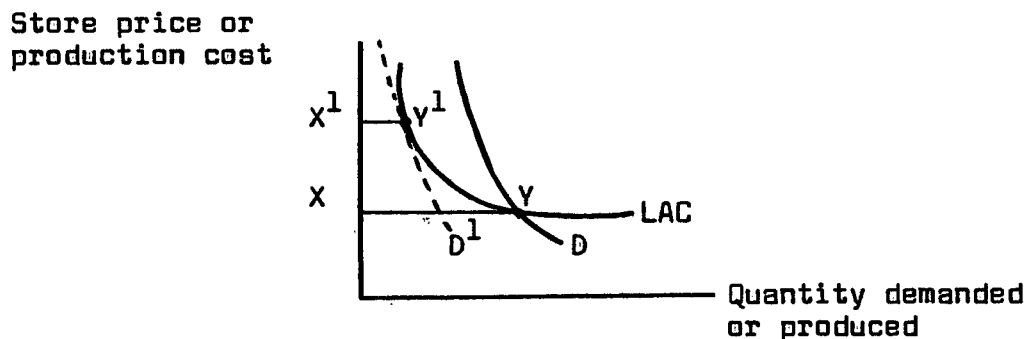
Source: Lösch, A., The Economics of Location (New Haven: Yale
         University Press, 1954) p. 106.

As firms enter the industry which is assumed to be monopolistically

competitive, profits are competed away to zero. This shifts the demand

curve D to D^1 since an hexagonal market area is smaller than the

circular market area which circumscribes it. The hexagon shrinks until

D^1 is tangent to the long-run average cost, LAC, curve at Y^1. Thus,

XY and X^1Y^1 respectively determine the maximum and minimum shipping

radius.[22]

Having started above with the lowest order good, Lösch develops
trading areas which look like various sized hexagonal nets, depending
on the product. Figure 2.VII shows the resultant hexagonal trading
areas each of which contains 18 outlying villages and one central
village (black dots represent a village).

<u>Figure 2.VII</u>. Lösch's three smallest market area sizes.
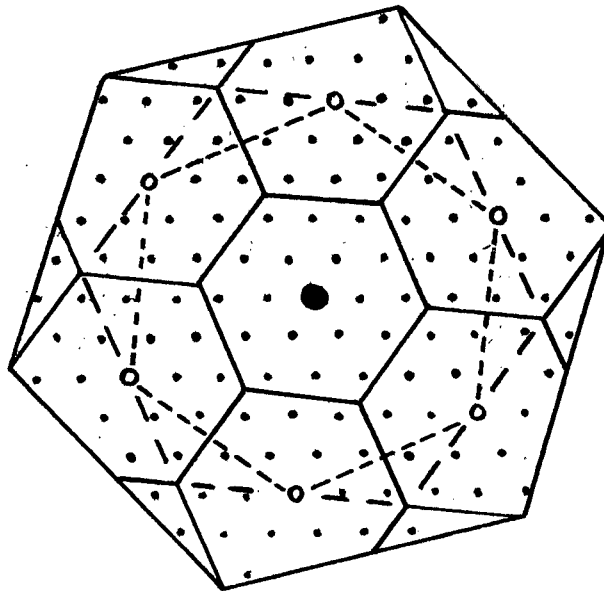
Source: Berry, B.J.L., <u>Geography of Market Centers and Retail
         Distribution</u>, (Prentice-Hall, Inc., Englewood Cliffs, N.J.,
         1967) p. 71.

The economic landscape, shown in Figure 2.VIII, is comprised of six
sectors where centres of production are scarce and six sectors where
they are frequent.[23] This landscape, predicated upon efficient
transportation linkages, provides analytical corroboration of Hoyt's
sector theory.

Figure 2.VIII. The Löschian economic landscape.
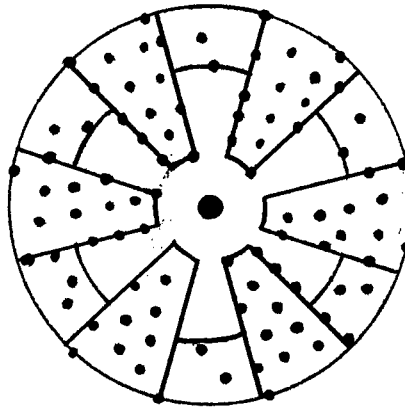
Source: Berry, B.J.L., <u>Geography of Market Centers and Retail</u>
          <u>Distribution</u>, (Prentice-Hall, Inc., Englewood Cliffs, N.J.,
          1967) p. 73.

Christaller takes a more inductive approach than Lösch and begins

with the most national commodity. It is assumed that consumers, living

on a uniform plain, require several goods and services.[24] In this

regard, Berry relates that:

> "each highest-order store location defines a central
> place from which all other goods and services will be
> provided. But the minimum size of market area required
> for support of successively lower-order goods will be
> progressively less than the hexagons for the highest-
> order good. Given that existing centers already provide
> all goods,...(an enterprising businessman succeeds at a
> new)...location exactly at the midpoint between three
> of the original places. The good will be one whose
> threshold market area around the new location is a hexagon
> exactly equal to the hexagonal market area for the same
> good as provided by each of the three existing centers.
> New centers providing the good may be located at the
> midpoint of every triangle of three metropolitan centers,
> and a second network of hexagons can be drawn completely
> covering the plain. All goods with threshold require-
> ments greater than hexagons of the smaller set and less
> than or equal to the larger are provided exclusively by
> the larger centers. All other goods may be provided by
> both levels of centers."[25]

Figure 2.IX shows the resultant hierarchy of market areas and centers

such that goods are grouped into orders dependent on market area

sizes.

Figure 2.IX. Christaller hierarchy based on the marketing principle.
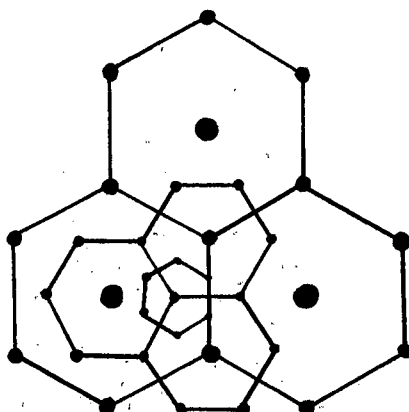
Source: Berry, B.J.L., <u>Geography of Market Centers and Retail Distribution</u>, (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1967) p. 65.

Figure 2.IX is based on the marketing principle because competing firms agglomerate on the assumption that the largest market centres provide a full range of different goods and services.

Christaller further developed two alternative hierarchies based upon the transport principle and administrative principle. The transport principle suggests that after the hexagonal distribution of metropolitan centres with corresponding market areas is derived, the next lowest centres locate at the midpoints of the transportation routes which bisect these metropolitan centres. Figure 2.X shows market areas, centre locations and transport routes in a hierarchy based on the transportation principle. Therefore, new centres locate between each pair of metropolises rather than lie midway among three metropolitan centres. This hierarchy maximizes the number of centres which locate on main transportation linkages.

To enable areal delegation of power, the administrative principle requires that each higher-order centre completely control an

Figure 2.X. Christaller hierarchy based on the transport principle.
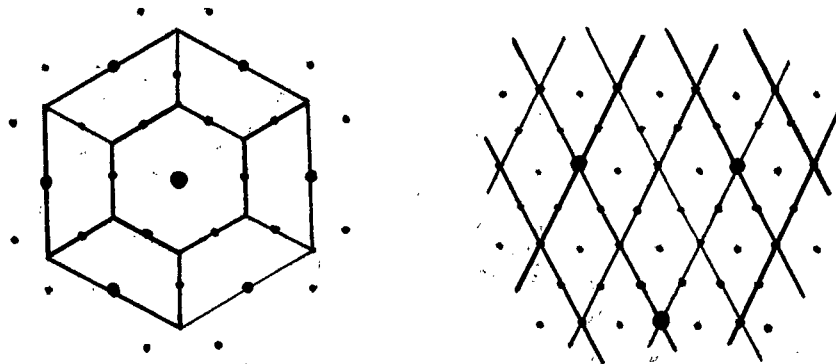
adjacent array of six lower-order centres. Figure 2.XI demonstrates the arrangement, nesting, and transport routes of a hierarchy based on the administrative principle.[26]

Figure 2.XI. Christaller hierarchy based on the administrative principle.
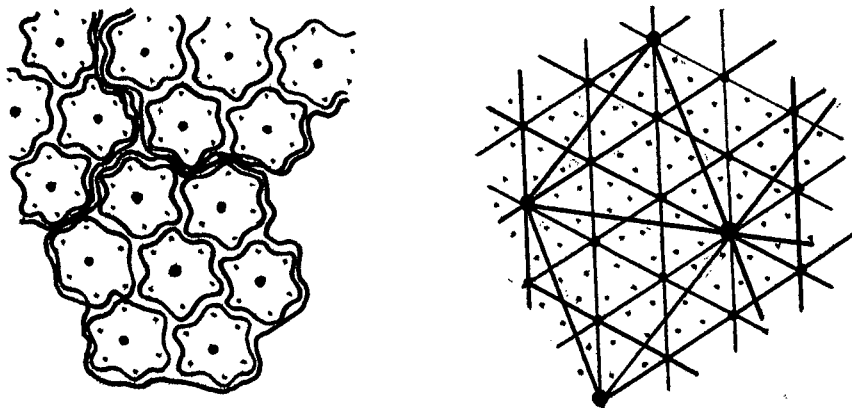
Given the above overview of central place theory, it is possible to extend the urban economic model so that the bid rent functions exist within a spatial hierarchy of centres. Figure 2.XII demonstrates

this extension where simplifying assumptions such as uniform transport costs are inoperative.

Figure 2.XII. Economic rent and a hierarchy of centres.
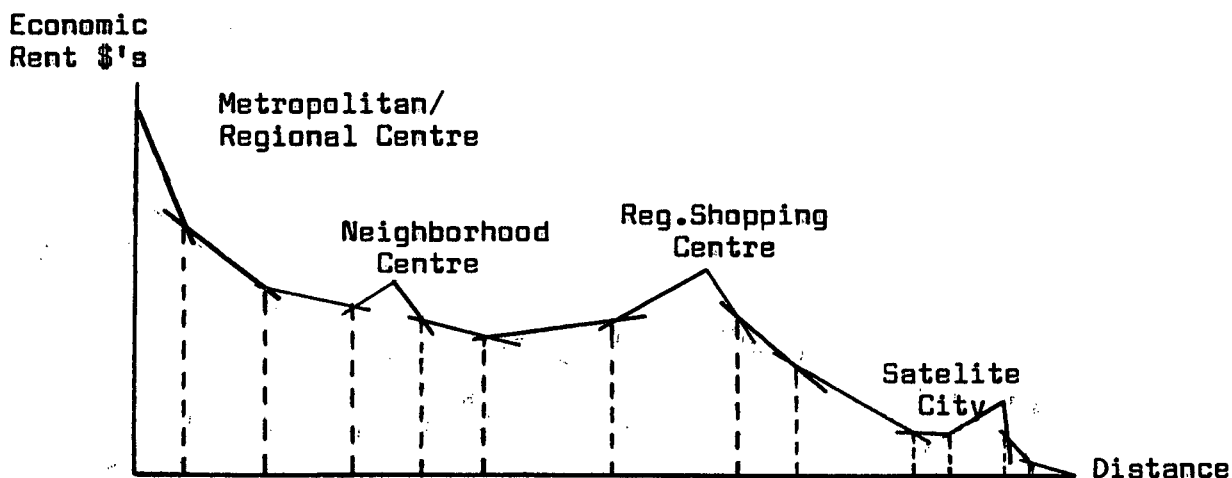
Source: Nourse, H.O., Regional Economics, (New York: McGraw-Hill Book Company, 1968) p. 120.

Central place theory and its extensions further enable efficient location decisions of service and retail functions, as well as an understanding of urban spatial relationships. Reilly, for example developed laws of retail gravitation which suggest that the trade area boundary between two towns X and Y, is, in kilometres from Y, equal to:

$$\frac{\text{kilometres between X and Y}}{1 + \sqrt{\dfrac{\text{size of X}}{\text{size of Y}}}} \qquad \text{(Eq.2.2)}$$

Good surrogates for size are population or number of central functions. Eq. 2.2 applies only to cities, larger regional centres, and rural areas. Eq. 2.3, an alternative equation to Eq. 2.2, is required for metropolitan regions because an absolute breaking point does not exist.

$$P_{A1} = \frac{\dfrac{S_1}{T_{A1}^{\alpha}}}{\displaystyle\sum_{i=1}^{r} \dfrac{S_i}{T_{Ai}^{\alpha}}} \qquad \text{(Eq. 2.3)}$$

where: P_{A1}: probability that a consumer located at A will visit centre 1.

r: the number of different shopping opportunities

S_i: the size of a particular shopping opportunity

T_{Ai}: travel time from A to a shopping opportunity of size S_i.

$P_{Ai} = 1.0$

α: a parameter which varies for different levels of the hierarchy.

Thus, Eq. 2.3 enables the computation of spatial probability curves for visiting a given metropolitan centre.[27]

Although central place theory provides some theoretical basis for intrametropolitan location theory, in particular service and retail firms, some criticism is in order. Essentially, much of the criticism of central place and other theories in this chapter, stems from their a priori reasoning. Conclusions are valid to the extent that the assumptions are correct; many of the assumptions, which seem intuitively appealing, are oversimplified.

Isard suggests Lösch only considers production sites which do not require raw materials, i.e. service firms, or exist in an environment where raw materials are readily available at equal costs. The realistic affect of spatial variations in input costs is ignored.[28] Vance further notes several criticisms, some of which are reproduced here:

"1. Its existence is an outgrowth of an areally based support within which relatively consistent spatial economies must be assumed.

2. "Retail gravitation" is the main force shaping settle-

ment patterns.

3. This gravitation is shaped by customer convenience, with distance built into the system in terms of a time-and-cost factor that determines decisions customers make about the "central place" they will visit.

4. Expansion in the system comes from growth in consumption, rather than production. Thus, growth is dispersed and must be focused through retail gravitation on a particular place to bring about change.

5. In central-place theory there is the basic assumption that the customer goes to the central place and, for that reason, access to goods and services can be seen in terms of the willingness of persons to move over a certain distance. Willingness is measured by distance not time.

6. The expression of change is mechanistic rather than variable, and it does not comprehend differences in human behavior or social objectives, either existing or historical.

7. Thus, the role of the entrepreneur is missing from central-place theory. Furthermore, the central-place structure is predicated upon a geographically closed system with the constraints it introduces. Notable among these is the inhibition of innovation in goods and demands.

8. It is not illogical, or against actual experience in some places, to argue for a central-place model. It is, however, both unjustified and unsupported to argue for the model as a timeless universal rather than an historically relevant special case."[29]

D. Ecological Theories of Urban Land Use

Alternative formulations derive a concentric location pattern of different urban land uses similar to the above urban economic model. Burgess,[30] in his study of the ecological processes in Chicago, developed a theory of "invasion and succession" in urban land use change. This change is characterized by the degree to which land is utilized for residential, commercial or industrial activities.

Figure 2.IV shows Burgess'[31] view of the city in five con-
centric zones.

Figure 2.IV. Burgess' Concentric Ring Theory

Commuter
zone

Residential
zone

Zone of
Workers' Homes

Zone in
Transition

C.B.D.
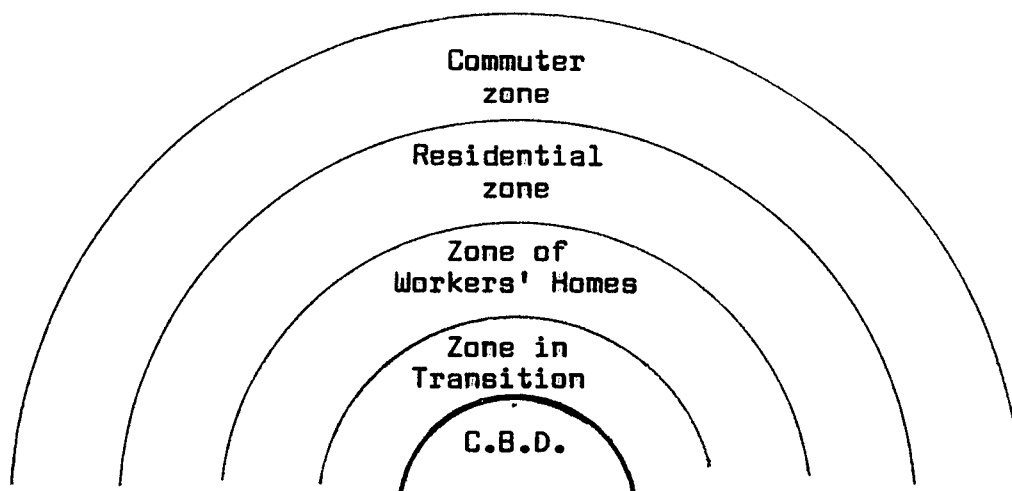
Source: Johnson, J.H., Urban Geography: An Introductory Analysis,
(Oxford, Permagon Press, 1966) p. 163.

The first zone is the central business district (C.B.D.). The second
is the transitional zone where older private houses are either in
the process of being usurped by offices and light industry, or being
subdivided to form smaller dwelling units. People in this zone live
either in poor housing or in the higher classed high rise apartments.
In the third zone are the independent working men's homes. These
labourers left the deteriorating transition zone to live in an area
accessible to their work. The residential zone consists of quality
apartment and duplex accommodation, as well as exclusive districts of
single family dwellings. The commuter zone, within one hour from the
C.B.D., consists of people from both inner and outlying areas. This
zone is essentially residential, its inhabitants trade off commuting
costs for ecological amenities.

Growth depends upon the expansion of population and the economy;
each zone invades the adjacent outer zone. Colby[32] suggests that

centrifugal and centripetal forces cause changes in urban land use patterns. Centrifugal forces, i.e. higher land costs, increased congestion, etc., compel certain functions to migrate outward from the C.B.D. Conversely, centripetal forces, i.e. accessibility to inputs, profitability, etc., attract other functions toward the C.B.D. These forces cause movement and interaction between zones whence the process of "invasion and succession" of urban land use evolves. The "invasion" process, caused by centripetal forces, commences with an inward migration of certain functions. The "succession" process is the aftermath of the "invasion" process. Here, centrifugal forces cause an outward migration of certain functions. Therefore, urban land use patterns continually change under the process of "invasion and succession".

Burgess' model ignores topography and transportation routes. Moreover, this is a model of a completely level city with equal accessibility in all directions.

Hoyt's[33] sector theory is a refinement over Burgess' theory because it considers the growth of similar land uses along transportation corridors. The sector theory applies mainly to residential land uses although extensions to other land uses are conceivable. Insofar as residential land uses are beyond the scope of this thesis, the location of residences influences where various firms cannot locate. The sector theory suggests that:

1. The city is circular with different residential areas appearing as wedge shaped sectors which radiate outward from the C.B.D. and

2. High priced areas tend over time to move outward to the periphery of a given sector.

This is based on the following assumptions:

"1. The various groups in the social order tend to
   be segregated into rather definite areas according
   to their incomes and social positions.

2. The highest income groups live in the houses which
   command highest prices and rents, while the lower
   income groups live in houses which are offered
   for the lower prices and rents.

3. The principal growth of American cities has taken
   place by new building at the periphery rather than
   the rebuilding of older areas."[34]

Hoyt relates that over time as the houses deteriorate the upper income

people seek new housing. They must move further away from the city

in order to obtain available building space for a new home. As they

move, their old homes become occupied by lower income people. Eventually

the whole neighbourhood changes.

This process of upper income people moving towards the periphery

and lower income groups moving into the old homes of the upper income

people is called the "filtering" process. Some causes of the "filtering"

process are: deterioration with age, outdated style, and a general

decline in the neighbourhood's character. Since mobility is a major

contingency of the "filtering" process,[35] Hoyt's sector theory is over-

simplified.

E. Other Theories of Urban Land Use

Parallel to the development of the literature in ecological

theories of urban land use were the land economists of the 1920's. The

most notable, Haig, suggests that location results from the tradeoff

between the limited complementarity of rent and the saving of transport

costs so as to maximize accessibility. These two cost items are only

complementary to a degree because their sum varies with the site.[36]

Therefore, the spatial pattern of a metropolis, "...tends to be de-

termined by a principle which may be termed the minimizing of the

costs of friction."[37] Haig's argument is criticized because site size

is not considered. Everyone could minimize the costs of friction

and maximize accessibility with the purchase of a small lot in a

very dense city centre. Moreover, firms such as retailers, tradeoff

sales volume with costs of friction rather than merely minimize the

costs of friction. Therefore, minimizing the costs of friction is

a sufficient criterion for intrametropolitan location only if all

other costs are assumed to be held equal.[38]

Harris and Ullman improved upon the single centre assumption

of Burgess' and Hoyt's theories by considering the propensity for

various land uses to cluster about several different nuclei throughout

the city. These nuclei develop due to topography, transportation, the

interdependency of various activities and the availability of certain

supporting functions at a given nucleus.[39]

Wendt, Ratcliff and Wingo make further modifications of the

theories of urban land use. Wendt criticizes the simplistic approach

of Haig, i.e. a single centre, and offers a "kitchen sink" theoretical

model for the aggregate value of urban land. Aggregate value is the

discounted aggregate income. Therefore, Wendt's theory deals with

cyclical changes in aggregate land values rather than the static equil-

ibrium and variations of intrametropolitan land values at one point

in time.[40]

Ratcliff provides a theory of urban dynamics based on "land

use succession". He states that, "...redevelopment...(or development)

...is justified if the present value of the new enterprise less the

capital cost of the new improvement is greater than the present value

of the existing property in original form."[41] This decision criterion,

consistent with the notion of competition, suggests that location/

relocation decisions result from the propensity of one use to outbid another.

Wingo developed an explicit mathematical model of the residential land market founded upon traffic analysis and the theories of land economists. Rents and transport costs are complementary, summing to the transport costs of the most peripheral site. Transport costs incorporate the dollar value of commuting time based on the marginal value of leisure time. Therefore, Wingo's model parallels von Thünen's agricultural model.[42]

F. Summary

This chapter is a brief review of some major theories which underlie the intrametropolitan location theory of certain firms. Although these theories offer some explanation of the urban land use of certain firms, they are too general and inadequate to specifically apply to a given metropolitan region. Their inadequacy results from a priori reasoning and over simplified assumptions whence a form of generality couched in terms of imprecision. Therefore, the scope of this thesis is to empirically determine which questionnaire variables (factors) influence the relative location/relocation behaviour of various firms located in the G.V.R.D. The next chapter considers metropolitan Vancouver in an historical and statistical context which is relevant to the intrametropolitan location of various firm categories located therein. This is reinforced with an overview of each firm category.

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CHAPTER   III

METROPOLITAN VANCOUVER - AN HISTORICAL, ECONOMIC
AND BUSINESS SECTOR SYNOPSIS

A. Introduction

This chapter presents an historical, economic and business
sector synopsis of Metropolitan Vancouver. This synopsis is only in-
tended to outline some topics which are relevant to the present location/
relocation, questionnaire study of firms located in the G.V.R.D. It
is beyond the scope of this thesis to develop these topics in detail.

More specifically, Metropolitan Vancouver is discussed in terms
of:

- historical development, spatial form and site qualities;

- land jurisdiction and ownership; and

- population and economic development.

Although these are very broad topics, a brief summary provides some
understanding of the study area of this intrametropolitan location
study. Furthermore, the generalized locational response of business
sectors to the study area is outlined for each firm category. Very brief
consideration is given to the intrametropolitan location theory of each
category; a map and the area of each category is presented where
feasible.

B. Metropolitan Vancouver

Overview of Historical Development, Spatial Form and Site
Qualities
a) Historical development
The beginnings of Vancouver came in 1884 with the extension of

the C.P.R. to the town of Granville, an area highly suited for a deepsea

port. Vancouver was incorporated in 1886; the first transcontinental

train arrived one year later, and the boom commenced. The population

reached some 13,000 people by 1890. A port flourished between Cambie

and Granville Streets. East of Cambie Street and north of Hastings

Street, the original retail and office centre was established in the

area known as Gastown. By 1900, the population doubled and Vancouver

became an established lumber manufacturing and port centre. Between

1900 and 1910, streetcar and other infrastructure accelerated growth to

a population of 100,000 people. Fishing became an important industry.

By 1915, some parts of B.C.'s interior were still quite remote to

Vancouver; direct rail and improved road links into the Caribou and Peace

River came in the 1950's.[1] Siemens relates that Vancouver,

> "...experienced economic ups and downs in the war and
> interwar years, with commensurate acceleration and
> deceleration of expansion in the various functions of
> the city and in in-migration. World War II and the
> post-war years saw a renewal of industry and trade, as
> well as major shifts in the city's functional zonation
> and a rapid areal expansion. Industry moved beyond the
> old industrial areas around Burrard Inlet and False Creek
> to the North Shore and the north arm of the Fraser and
> eastward along the Great Northern and Canadian National
> tracks. Suburbanization became "sprawl," and unsightly
> "ribbon developments" extended along the main roads out
> of the metropolitan area."[2]

b) Spatial form
Concommitant with Vancouver's rapid growth has been its integ-

ration with the surrounding, low density, nucleated settlements such

as New Westminister. The broad theories outlined in Chapter II are

either too general or of an historical nature, and inadequately

explain the resultant spatial form. Hardwick describes the present

spatial form of metropolitan Vancouver as two concentric rings

whereby:

> "The centre ring is a radially organized city focused on
> the traditional central business district. The outer
> ring is a circumferentially-organized urbanized area
> made up of a series of interconnected communities and
> work-places. Although some interaction takes place
> along the interface between the two systems, there is
> more interaction within the systems than between them."[3]

This "core-ring" form is characterized by the region's unique site

qualities.

Figure 3.I shows the 20 minute isochrone which forms the boundary

between the central and peripheral system. The central system con-

sists of Vancouver, West Vancouver and a residential portion of North

Vancouver district (not city). Since the urban models of the 1920's

influenced Vancouver's zoning, Vancouver has residential areas pro-

jected upon a modified concentric ring pattern of central land uses.[4]

Hardwick states that:

> "....Office towers dominate the waterfront-facing C.B.D.
> and high-rise apartments crowd the adjacent West End.
> Surrounding this central area is a zone of transition
> where waterfront, warehouse, and industrial functions
> are being phased out. Beyond this zone, apartments
> and converted homes provide a large inner city housing
> area, testifying to the existence of a filtering process
> in past decades. This high-density residential zone
> blends into the old suburban single family areas, where,
> as in many cities that expanded rapidly in the 1920's,
> there are socially-segregated neighbourhoods organized
> along streetcar ribbons."[5]

The northern component of the central system consists of residential

commuters who live within 6 miles of the C.B.D.[6]

The peripheral system, with its discontinuous settlement,

includes the municipalities of New Westminister, Coquitlam, Surrey,

Coast Mountains

Grouse Mtn.

Mt.Seymour

North Vancouver

Legend:
- Major single family areas
- Rurban Surrey Upland
- Main Apartment Areas
- Main Industrial Areas
- CBDs and Major Shopping Centers
- Main Public Open Space
- Non-urban Uses – Agricultural and Forest Land
- —— Freeway and arterials
- ----- 20 minute CBD Isochrone

scale in Miles 0 1 2 3 4

N

Burrard   Inlet

UBC

Vancouver

Coquitlam

Burnaby

New Westminster

Airport

Richmond

Surrey

Fraser

Delta

Ladner

Boundary Bay

Roberts Bank

White Rock

Stage 1   Tsawwassen

"Core-Ring Model"

- Central Radially-Organized System
- Peripheral Circumferentially-Organized System

Figure 3.I   Greater Vancouver Region, 1971.

and Rmnd., and large portions of Burnaby and Delta.[7] Hardwick suggests

that,

> "...The peripheral system is poly-nucleated, inter-
> connected by a well developed system of freeways,
> arterial roads, railways, and navigable waterways.
> As suggested by the "core-ring" model, more residents
> find employment, shopping, and recreational opportunities
> within this system than within the Vancouver C.B.D.-
> oriented system... The recent expansion of population
> in the peripheral ring is related to growth of local
> economic activity rather than to growth in the core
> city. The construction of freeways has improved access
> between residential areas, work, and shopping within
> the outer municipalities, but because the freeways stop
> at the borders of Vancouver interaction with the core
> system is restricted."[8]

In summary, the managerial, professional, clerical and service occu-

pations characterize the central system; some industrial and wholesale

firms are moving to the peripheral system. Regional shopping centres

and related services, as well as public institutions, also fulfill the

needs of peripheral neighbourhoods.[9]

Metropolitan Vancouver is comprised of all fourteen municipal-

ities in Greater Vancouver as well as the electoral areas of the

University Endowment Lands, Ioco-Buntzen, and Bowen Island. The Greater

Vancouver municipalities are: Vancouver, Burnaby, New Westminister,

North Vancouver City and District, West Vancouver, Coquitlam, Port

Coquitlam, Port Moody, Richmond, Surrey, White Rock, Delta, Lions Bay.

Metropolitan Vancouver and the Greater Vancouver Regional District

(G.V.R.D.) are both the same geographical areas by definition. However,

the G.V.R.D. also refers to the regional government whose domain is

Metropolitan Vancouver.

c) Site Qualities

Metropolitan Vancouver, situated at the western end of the

Lower Fraser Valley, is located in the southwest corner of the British

Columbia mainland. Vancouver "...is the third largest metropolitan

area in Canada encompassing...(approximately)...half of the provincial
population of over 2,000,000."[10]   Here, "...the Lower Fraser Valley
affords a relatively easy route way through the coast batholith,
and virtually the only part of the coast with a climate, topography
and soils conducive to intensive agricultural and urban development."[11]
Stager and Wallis suggest that this climate is relatively mild with
a "...mean annual temperature...around 50°F. It may be one or two
degrees higher in and around Metropolitan Vancouver...."[12]   Greater
Vancouver has at least 200 frost free days. However, the variability
of frost is a particular concern of farmers because it is uncertain
precisely when the last spring frost is over. Compared to other
Canadian urban areas, the region is a rather wet climate with great
spatial variability in its precipitation levels.[13]   Examples of yearly
precipitation levels are:

> "Ladner 36", Vancouver Airport 41", Vancouver Dunbar 52",
> Vancouver City 60", Cypress Park (West Vancouver) 67",
> Hollyburn Ridge 113"."[14]

It is noted that most of the precipitation falls as rain; only about
5% falls as snow.[15]

The topography of the Lower Fraser Valley is quite flat with
less than 500 feet of relief in most areas.[16]   This plain, which often
requires dyking, is subject to periodic flooding in several areas
and poses a constraint on potential uses.[17]   The region is bounded to
the north by the Coast Mountain Range and to the southeast by the Cascade
Mountains. Elevations of 3,000 to 4,000 feet are common in the
mountainous areas.[18]   A further topographic feature of Metropolitan
Vancouver is its ice-free, natural harbour. This harbour is readily
accessible to the Pacific Ocean yet sheltered from open waters by
Vancouver Island.

Although about one-half of the Valley has good soil for
agriculture[19], Winter states that, "...an unfortunate truth about the
Lower Fraser Valley is that it has no really first-class agricultural
soils."[20] Soil foundation conditions, particularly important for
urban areas, are discussed later in this chapter.

Outline of Land Jurisdiction and Ownership
a) Land jurisdiction

Given the above overview of Metropolitan Vancouver's historical
development, spatial form and unique site qualities, a brief review
of the jurisdcition and ownership of the port and dry land is required.
Figure 3.II shows the three federal organizations which administrate
certain waterways in Metropolitan Vancouver. Control exercised depends
on the nature of ownership of the land covered by water (Figure 3.III).
National Harbours Board (N.H.B.) exert the strongest control over the
inner harbour. This is because its ownership of the ocean floor and
control of shipping and navigation enables this Board to lease these
lands for a given use. In those waterways where the Provincial Govern-
ment or private interests own the sea, river bottom or foreshore;
Federal control is lessened because the precise nature of this juris-
dicition is not clearly established.[21] The two Harbour Commissions
receive minimal interference from the N.H.B. because they consistently
provide a profitable operation. Moreover, there is cooperation with
the Provincial Government who provide their water lands and a share
of the revenue in return for the administration of their harbour
jurisdiction. Two factors further contribute to the Harbour Commission's
success:

1. The profit motive creates an efficient operation.
2. Constraints and contingencies are dealt with effectively
   because several of the commissioners are locally based
   members.[22]

Figure 3.II.   Greater Vancouver Regional District: Harbour
                Administration.

Fraser River Harbour Commission

North Fraser Harbour Commissioners

National Harbours Board

N

0   1   2   3
Miles
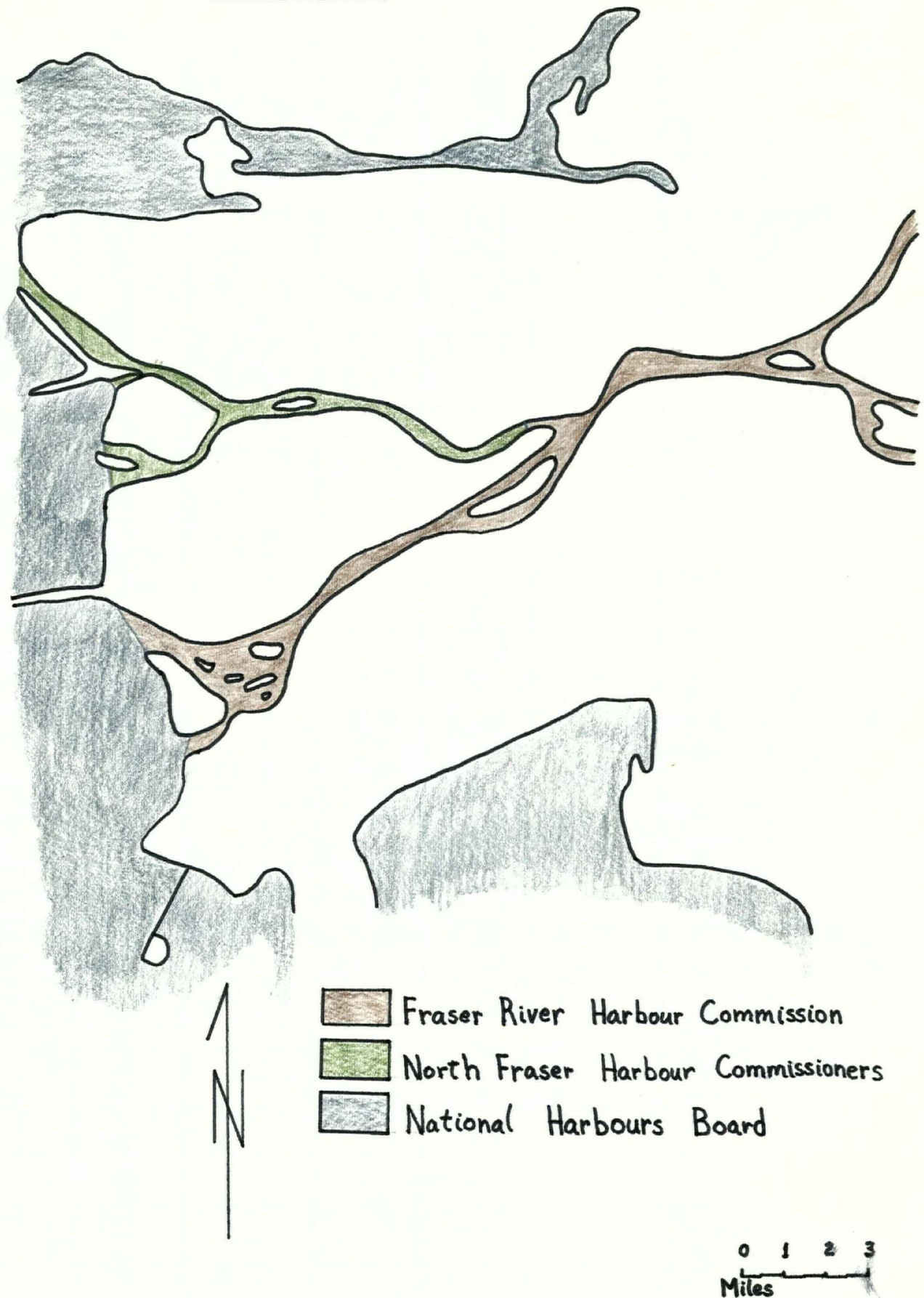
Source: Griggs, N.J.F., _Urban Growth and Transportation Implications_
          in Port Development: A Case Study, Vancouver, B.C.
          (Unpublished M.A. Thesis, U.B.C.: 1967) p. 197.

Figure 3.III   Greater Vancouver Regional District: Ownership
                 of Land Covered by Water

Gov't of Canada

Gov't of B.C.

Private

Further control of navigable waters is attributable to the
planning function of Municipal organizations. All municipalities in
the Greater Vancouver area border on, or extend into navigable water.
To implement planning and land use decisions, all municipalities
use zoning by-laws. Municipal zoning is effective only to the extent
that a municipality can forego increased tax and assessment revenue
rendered by market demands for changes in land use or intensity. Few,
if any, municipalities can afford losses of revenue opportunities.
The Provincial government can also amend or improve all Municipal
legislation. Therefore, Municipal control of navigable waters as well
as dry land is relatively limited.[23]

A regional government, the G.V.R.D., coordinates the relatively
ineffective control of the municipalities. The G.V.R.D. assumes
functions which are impractical for a given municipality to undertake,
either because they involve several municipalities or because they
require large finances. The G.V.R.D. approaches area problems and
provides necessary services such as regional planning on a cooperative
basis. Consequently, all municipalities in the G.V.R.D. participate
in the planning function. The G.V.R.D. is further responsible for
hospitals, parks, water supply, provision of sewerage facilities,
housing and air pollution.[24]

Railroads have further jurisdiction over dry land due to their
incorporating legislation. This legislation provides for the right
of expropriation and the right to acquire land. Railroads are also
subject to both Federal and Provincial legislation.[25]

The Federal Government gains jurisdiction over dry land
primarily through The Expropriation Act of Canada. Section 3 of this

Act provides:

> "Any interest in land, that, in the opinion of the
> Minister, is required by the Crown for a public work
> or other public purpose may be expropriated by the
> Crown in accordance with the provisions of this Part."[26]

and Section 4(1):

> "Whenever, in the opinion of the Minister, any interest
> in land is required by the Crown for a public work or
> other public purpose, the Minister may request the
> Attorney General of Canada to register a notice of in-
> tention to expropriate such interest, etc."[27]
> b) Land Ownership
> Given the above jurisdictional considerations, very brief

attention must be paid to the rights of ownership over port and dry

land. The greatest interest in real property is called fee simple.

Ring suggests that even a fee simple estate,

> "....is subject to certain Government limitations
> on ownership, imposed for the mutual welfare of all
> citizens. These limitations fall under:
>   1. The police power of government.
>   2. The right of eminent domain.
>   3. The right of taxation.
>   4. Escheat to the state."[28]

The Land Registry Act of British Columbia implements the modified

Torrens system in order to establish land interests. Aside from the

registration of titles, modifications enable the registration of any

acceptable instruments, i.e. options, agreements for sale, etc. under

Section 53 and the registration of trusts under Section 149.[29]

An advantage of the Torrens system is the clear definition of

the rights of all parties. Security of title is provided by the

principal of indefeasibility which means that which cannot be made

void, destroyed or forfeited. Invoking this principal,

> "...The main object of the Act...is to save persons
> dealing with registered proprietors from the trouble
> and expense of going behind the register, in order
> to investigate the history of their author's title,
> and to satisfy themselves of its validity. That end

is accomplished by providing that every one who
purchases, in bona fide and for value, from a
registered proprietor, and enters his...(interest)
...on the register, shall thereby acquire an in-
defeasible right, notwithstanding the infirmity of
his author's title."[30]

Should anyone lose his right to land through the operation of the Act,

an assurance fund provides reimbursement.[31]

Lands completely covered with water are not typically the

subject of certificates of indefeasible title. However, Davis suggests

that if a stream flows through private land,

"...there is ownership in the bed of the river...
If the stream is navigable the public will have a
right to pass up and down upon the water, the con-
verse holds if it is not navigable. If the river
forms the boundaries of two properties, each owner
will own to the middle."[32]

In Johnson v. Anderson, it is held that,

"...the riparian owner still has the right to make
use of such water and still has a remedy against a
wholly wrongful and unauthorized diversion of the
stream which deprives him of such right..."[33]

Therefore, in the case of land covered with water, as well as dry land,

legislation covers the rights of ownership.

Figure 3.III shows the ownership of land covered by water.

Most of the inner harbour is owned by the Federal Government except

for a few private ownerships of which the Canadian Pacific Railway

Company (C.P.R.) is the principal owner.[34] Griggs further relates that,

"...the Federal Government is the owner of all lands
seaward from the ordinary low water mark, outside of
the bays, harbours and estuaries, to the outer limit
of the terretorial sea of Canada..."[35]

The Provincial Government owns,

"...most of the lands seaward from high water from
the First Narrows to the Port of Vancouver limits, and
of most of the remaining lands below high water mark
in the metropolitan Vancouver area, including the
Fraser River and False Creek."[36]

Private interests have some holdings in the Fraser River and False

Creek.

On dry land, the Federal Government, "...is limited to holdings

of Indian reserves, defence establishments,...(Vancouver International

Airport)..., and some other waterfront lands in Burrard Inlet and

False Creek."[37] The Provincial Government owns all dry land, "...that

has not been alienated,...(including)...all streets and roads in

unorganized territory and municipalities except Vancouver."[38] The

Municipality of Vancouver owns all streets and public access within

its jurisdiction.[39] Railways such as the C.P.R. further own the lands

associated with their trackage and other facilities.

The remaining land in the G.V.R.D. is privately held by several

individuals and private corporations.

Population and Economic Summary

a) Population
Any discussion of a regional economy must necessarily consider

that region's population.

Table 3.I shows that for the past twenty years, the population

of the G.V.R.D. has remained at about 48% of the population of B.C.

The present G.V.R.D. population is approximately one million persons.

Table 3.II shows the population distribution of locations used in

this study. (A map of these locations is shown in Figure 5.I).

The larger populations reside in the municipalities of Vancouver,

Burnaby, and Surrey.

The rapid growth of both the G.V.R.D. and B.C. populations

is attributable to relatively high migration and low birth rates.

It is felt that various amenities such as transportation facilities,

Table 3.I   Population of the G.V.R.D. Compared to B.C.

Year	Population of B.C. ('000's)	Population G.V.R.D. ('000's)	%
1971	2,184.6	1,021.8	47
1965	1,797.0	887.4	49
1961	1,629.1	783.7	48
1956	1,398.5	664.6	48
1951	1,165.2	557.1	48

Sources: Municipal Statistics, 1951-1971, The Department of Municipal Affairs, Victoria, B.C.

"Population 1921-1971", D.B.S., Ottawa: Catalogue #91-512.

Table 3.II   Population of Locations used in this Study.

Municipality	1971 Census	1966 Census	1961 Census	1956 Census	1951 Census
New Westminster	42,835	38,013	33,654	31,665	28,639
North Vancouver	31,847	26,851	23,656	19,951	15,687
Port Moody	10,778	7,021	4,789	2,713	2,246
Vancouver:					
C.B.D.	44,260	40,793	33,577	32,482	36,221
Zone 2	101,770	102,428	95,774	95,299	74,182
Zone 3	104,300	100,813	90,845	83,577	99,914
Zone 4	179,445	169,320	155,833	146,695	136,636
Burnaby	125,660	112,036	100,157	83,745	58,376
Coquitlam	53,230	40,916	29,053	20,800	15,697
Delta	45,860	20,664	14,597	8,752	6,701
Richmond	62,121	50,460	43,323	25,978	19,186
Surrey	98,601	81,826	70,838	49,366	33,670
West Vancouver	36,440	31,987	25,454	19,197	13,990

Source: Municipal Statistics, 1951-1971, The Department of Municipal Affairs, Victoria, B.C.

a favourable environment and other factors, some of which comprise

the questionnaire variables, cause the economic base to grow whence

the population increment via migration. Growth of Metropolitan

Vancouver is expected to increase at about 14% for each of the next

five year periods. Larger rates of growth are anticipated for the

North Shore, South Vancouver, Richmond, Delta, and Port Moody.[40]
        b) Economic Development
        The structure of Metropolitan Vancouver's economic base is

characterized by, "...a transportation focus where transcontinental

highways, railways and airways converge on the Greater Vancouver port."[41]

The destinies of Vancouver's economy and its port are directly related.

Duncan suggests that,

> This is illustrated by the fact that the 1971 payroll
> covering Longshoremen in the Lower Mainland amounted to
> more than $50 million. Aside entirely from direct wages,
> there are many businesses in all port cities that are
> dependent on port activities. These include all manner
> of services from ships chandlers and tug boats to
> laundries and taxi cabs. It is estimated that for each
> ton of cargo passing through the port of Vancouver, the
> local economy is enhanced by about fifteen dollars. This
> suggests that the 35 million tons of cargo handled in
> 1971 generated some $500 million."[42]

    Table 3.III summarizes the cargo tonnages for Vancouver Harbour

in 1969 and 1970.

Table 3.III. Summary Statistics for Vancouver Harbour, 1969 and 1970

	Vessel Arrivals No.	Vessel Tonnage No.	Cargo Tonnage No.	Grain Elevator Shipments Bu.
1969	19,105	21,283,905	23,080,469	162,292,838
1970	17,276	23,853,639	27,158,913	215,712,297

Source: Canada Year Book, 1972, D.B.S., Cat. No. CS-11-202/1972.

Approximately 38 million tons of cargo were shipped from Vancouver
Harbour in 1972.[43] New Westminster shipped about 5 million tons in
1969. The largest international export tonnages shipped from Vancouver
Harbour in 1969 were: wheat, potash, sulpher in ores, and bituminous
coal in that order. The largest international import tonnages con-
sisted of: sand and gravel, fuel oil, salt, and other commodities
not listed. Coastwise tonnages were largest for exports of: pulpwood,
fuel oil, hogged fuel, and gasoline while the largest imports con-
sisted of: sand and gravel, logs, newsprint.[44] Therefore, resource
industries significantly depend on the port of Vancouver to distribute
their goods to market.

In order to comprehend the meaning of these shipping tonnages,
a comparison with other ports is required. Duncan states that,

> "The port of Vancouver is the largest on the west coast
> of North America, substantially exceeding the tonnage
> handled by such ports as Seattle, San Francisco, and
> Los Angeles. Indeed, the port of Vancouver ranks within
> the leading fifteen ports of the world."[45]

Port activity also flourishes in peripheral areas due to in-
creased shipments of coal, sulphur, and fertilizers through the
terminals at Port Moody, North Vancouver and Roberts Bank. Table 3.IV
shows that these commodities rather than lumber or grain explain the
continued growth of peripheral ports and port related activities.[46]

Table 3.IV. Foreign Cargo by Commodity, in millions of tons.

	1965	1966	1967
Wheat	3.6	4.2	3.4
Lumber	1.3	1.1	1.2
Coal	.4	.8	1.1
Sulphur	.5	.5	.8
Fertilizer	.7	1.1	1.1

Source: Hardwick, W.G., "Vancouver: the Emergence of a 'Core-Ring'
         Urban Pattern" in Geographical Approaches to Canadian
         Problems, Gentlicore, A.L. (ed.), (Scarborough, Ont.:
         Prentice-Hall, Inc., 1971) p. 117, as quoted from the
         Dominion Bureau of Statistics Report, Cat. #54-203, 1968.

The following discussion of Greater Vancouver's economic base
is limited to the number of categories with available statistics. This
situation is due to the secrecy provisions of the Statistics Act.

The economic base of Metropolitan Vancouver is somewhat re-
flected by the distribution of the labour force amongst the various
economic sectors. It is noted that the economic base is not solely re-
flected by the number of employees because productivity can increase
with automation and fewer employees. Thus, a large portion of the
primary sector is capital rather than labour intensive.

Table 3.V shows the total employment for Greater Vancouver by
industry. In general, much of the labour force is employed in the
manufacturing and service sectors. The majority of employees work in
the durable goods category of the manufacturing sector and in either

the finance/real estate or personal services category of the service

sector. Table 3.V also shows that in the past ten years, substantial

employment growth occurred in the manufacturing, service, trade,

and infrastructure categories.

Wages provide some indication of the more profitable portions

of the economic base. Table 3.VI shows the average weekly earnings

by industry for Greater Vancouver. Construction categories by far

have the highest weekly salaries. This is followed by the manu-

facturing sector, in particular the paper and allied industries

category; wholesalers; and the transportation and water service

categories of the infrastructure sector. Retail and service sectors

earn considerably lower weekly salaries than the other sectors. Thus,

the manufacturing sector employs the largest number of people and

pays relatively well, while the service sector pays quite low and

employs a large number of people. It therefore appears that, in terms

of wages and number of employees, manufacturing is the most dominant

sector of Metropolitan Vancouver.

The location quotient method helps to identify those sectors

of the Greater Vancouver economy which significantly contribute to the

economic base. The location quotient measures, "...the extent to

which employment in a given industry category in the city exceeds or

falls short of the pro rata share of that city in total...(provincial

or)...national employment."[47] Table 3.VII presents a business structure

analysis via location quotients of Greater Vancouver. These location

quotients were calculated for November, 1972 in order to coincide with

the time of the questionnaire study. For analytical purposes, a

"distinctive" industry has a location quotient which exceeds 1.10 while

a "dominant" industry has a quotient greater than 1.50. It is cautioned

Table 3.V. Employment by Industry for Urban Areas ('000's): Greater Vancouver[1]

SIC #	Industry	Feb. '73	Feb. '72	Jan. '71	Jan. '70	Jan. '69	Feb.'64
100-399	Manufacturing	59.3	58.7	55.6	60.0	56.4	46.0
	Durable Goods	34.5	34.9	32.0	36.2	34.0	
	Non-durable Goods	24.8	23.8	23.5	23.8	22.4	
100-147	Food and Beverages	9.7	9.0	8.9	9.0	8.9	6.9
100-139	Foods	8.1	7.4	7.4	7.6	7.5	
250-259	Wood Products	13.6	14.2	13.4	14.6	15.1	15.6
251	Saw, Shingle and Planing Mills	6.4	7.1	6.8	7.2	7.7	13.8
252	Veneer and Plywood Mills	4.9	4.9	4.9	5.3	5.4	
270-274	Paper and Allied Industries	4.6	4.3	4.5	4.7	4.1	2.7
300-309	Metal Febricating Industries	5.9	5.9	5.6	6.0	5.1	6.9
400-421	Construction	11.3	14.0	10.9	11.4	9.6	10.9
404,421	Building	8.9	10.9	9.5	9.8	8.2	7.9
404	General Contractors	4.9	5.1	5.4	4.8	4.5	
421	Special Trade Contractors	3.9	5.7	4.1	5.0	3.6	
500-579	Transport, communic., & other utilities	38.2	36.5	32.6	32.9	30.4	19.2
	Transportation Equipment						3.1
	Public Utility Operation						3.2
500-519	Transportation	19.2	18.5	15.5	17.0	16.0	
504-505	Water Transport and Services	7.3	7.3	6.4	7.2	7.1	6.1
543-548	Communication	11.6	10.9	10.3	9.1	8.1	6.5

Table 3.V. (continued)

SIC #	Industry	Feb. '73	Feb. '72	Jan. '71	Jan. '70	Jan. '69	Feb. '64
600-699	Trade	49.7	48.6	44.1	46.4	44.1	35.5
600-629	Wholesale Trade	17.6	17.3	16.4	17.0	15.9	14.0
630-699	Retail Trade	32.1	31.4	27.8	24.4	28.2	21.5
631	Food Stores	5.4	5.3	4.7	5.1	4.7	
642	Department Stores	15.7	14.0	13.3	14.3	14.4	
700-737	Finance, Insurance & Real Estate	17.3	16.7	15.8	15.3	13.8	
702-704	Financial Institutions	11.2	10.1	9.8	9.7	8.3	
731-737	Insurance and Real Estate	6.1	6.6	6.0	5.6	5.4	
731	Insurance Carriers	3.6	4.0	3.9	3.8	3.7	
850-899	Service	31.6	32.0	30.5	29.8	26.1	14.7
861-869	Business Services	8.9	8.4	8.8	8.5	7.4	
871-879	Personal Services	12.8	14.6	12.6	13.2	11.8	
875	Hotels, Restaurants and Taverns	11.7	13.7	11.4	11.7	10.4	
031-899	Industrial Composite	208.1	207.3	190.2	196.6	181.0	140.0

Source: "Employment Earnings and Hours", D.B.S., Ottawa; Catalogue 72-002, Monthly.

[1]This table is constructed from data which apply to the Vancouver Census Metropolitan Area (CMA). This area is essentially the G.V.R.D. with Bowen Island and Lion's Bay excluded.

Table 3.VI.   Average Weekly Earnings by Industry ($'s):   Greater Vancouver.[1]

SIC #	Industry	Feb.'73	Feb.'72	Feb.'71	Jan.'70	Jan.'69	Jan.'68	Jan.'67	Jan.'66	Jan.'65
100-399	Manufacturing	184.89	170.19	150.38	143.13	129.09	121.25	113.27	107.30	102.55
	Durable Goods	192.08	175.30	153.13	147.17	131.63	124.08	108.46	109.34	105.30
	Non-durable Goods	174.90	162.68	146.54	137.00	125.29	117.17	109.57	104.19	98.54
100-147	Food and Beverages	172.89	159.22	143.59	133.08	121.96	112.37	104.94	99.15	96.50
100-139	Foods	169.99	155.73	140.02	132.63	120.61	111.01	102.83	97.36	94.24
250-259	Wood Products	186.02	168.78	138.78	140.28	126.47	123.86	115.30	109.15	106.34
251	Saw, Shingle and Planing Mills	188.03	170.32	142.20	135.95	129.26	124.69	115.70	110.53	105.26
252	Veneer and Plywood Mills	176.86	162.26	158.76	141.00	116.70	120.14	112.24	103.93	105.39
270-274	Paper and Allied Industries	215.65	200.29	124.39	172.77	156.65	145.00	135.79	129.04	117.32
300-309	Metal Febricating Industries	194.34	175.71	180.39	151.27	134.00	122.81			
400-421	Construction	233.39	236.88	194.83	174.76	145.68	141.49	144.28	130.07	116.93
404,421	Building	229.53	228.46	194.08	173.73	145.11	140.50	143.88	128.82	116.56
404	General Contractors	220.52	222.85	191.39	168.28	140.84	139.11			
421	Special Trade Contractors	240.86	233.47	197.54	178.94	149.83	142.10			
500-579	Transport, communic. & other utilities	195.23	181.99	161.97	149.49	140.11	131.19	128.10	118.19	109.35
	Transportation Equipment									
	Public Utility Operation									
500-519	Transportation	199.67	185.16	173.45	150.06	139.37	131.12			
504-505	Water Transport and Services	202.90	197.32	188.37	154.82	144.87	139.43			

Table 3.VI. (continued)

SIC #	Industry	Feb.'73	Feb.'72	Feb.'71	Jan.'70	Jan.'69	Jan.'68	Jan.'67	Jan.'66	Jan.'65
543-548	Communication	174.75	167.71	131.84	135.35	126.42	121.44			
600-699	Trade	144.57	130.88	116.56	114.91	104.63	95.65	88.40	85.60	82.89
600-629	Wholesale Trade	182.54	168.07	155.37	140.42	130.08	119.05			
630-699	Retail Trade	123.74	110.41	93.57	100.21	90.34	82.55			
631	Food Stores	155.52	132.92	54.06	109.55	90.46	82.62			
642	Department Stores	103.64	98.91	93.46	90.75	84.33	74.82			
700-737	Finance, Insurance & Real Estate	149.64	142.01	127.20	120.74	116.86	102.85	98.15	95.77	88.91
702.704	Financial Institutions	148.41	140.36	125.93	121.25	120.19	103.16			
731-737	Insurance and Real Estate	151.91	144.55	129.36	119.86	111.64	102.40			
731	Insurance Carriers	146.72	149.36	131.69	117.08	111.61	103.35			
850-899	Service	126.00	112.46	108.20	99.10	92.74	86.19	85.54	81.64	73.60
861-869	Business Services	184.42	173.51	159.92	148.04	137.03	129.49			
871-879	Personal Services	92.60	81.67	78.70	72.73	70.38	62.92			
875	Hotels, Restaurants and Taverns	90.19	79.76	74.13	70.39	69.14	61.63			
031-899	Industrial Composite	168.00	156.53	139.09	131.02	119.73	111.88	107.33	101.80	95.85

Source: "Employment Earnings and Hours", D.B.S., Ottawa: Catalogue 72-002, Monthly.

[1]This table is constructed from data which apply to the Vancouver Census Metropolitan Area (CMA). This area is essentially the G.V.R.D. with Bowen Island and Lion's Bay excluded.

Table 3.VII. Business Structure Analysis of Greater Vancouver,[1]
            November 1972.

SIC Group and Industry	No. of Employees Vancouver (,000's)	Location Quotient (Canada)[3]	Location Quotient (B.C.)[4]
I. Primary Industries			
400-421 Construction	13.1		
404,421 Building	10.1 (77.1%)[2]	1.15	1.18
404 General Contractors	5.5 (42)	1.48	1.11
421 Special Trade Contractors	4.6 (35.1)	.9	1.28
II. Manufacturing			
100-399 Manufacturing	59.7		
Durable Goods	34.4 (57.6)	1.17	.95
Non-Durable Goods	25.3 (42.4)	.83	1.07
100-147 Food and beverages	10.2 (17.1)	1.34	1.31
100-139 Foods	8.5 (14.2)	1.29	1.28
250-259 Wood Products	13.7 (23)	3.97	.65
251 Saw, Shingle & Planing Mills	6.3 (10.6)	3.11	.41
252 Veneer & Plywood Mills	5.0 (8.4)	8.4	1.25
270-274 Paper & Allied Industries	4.6 (7.7)	1.03	.51
300-309 Metal Febricating Industries	5.9 (9.9)	1.4	1.8
III. Retail Trade			
600-699 Trade	53.2		
630-699 Retail Trade	35.2 (66.2)	.96	.97
631 Food Stores	5.6 (10.5)	.80	.90
642 Department Stores	18.1 (34)	1.43	1.1
IV. Wholesale Trade			
600-699 Trade	53.2		
600-629 Wholesale Trade	17.9 (33.7)	1.08	1.06

Table 3.VII. Business Structure Analysis of Greater Vancouver,
            November 1972 (continued)

SIC Group and Industry	No. of Employees Vancouver (.000's)	Location Quotient (Canada)	Location Quotient (B.C.)
V. Infrastructure			
500-579 Transp., Communic. & other utilities	37.8		
500-519 Transportation	19.0 (50.3)	.85	.80
504-505 Water Transport & Services	7.1 (18.8)	3.3	1.54
543-548 Communication	11.3 (29.9)	1.2	1.26
VI. Financial & Admin. Services			
700-899 Total service	49.6		
700-737 Finance, Ins., Real Estate	17.2 (34.7)	.88	.97
702-704 Financial Institutions	10.8 (21.8)	.9	.88
731-737 Insurance & R. Est.	6.4 (12.9)	.84	1.15
731 Insurance Carriers	3.8 (7.7)	.69	N.A.[5]
850-899 Service	32.4 (65.3)	1.08	1.02
861-869 Business Serv.	8.7 (17.5)	1.22	1.27
871-879 Personal Serv.	14.4 (29.0)	1.06	.81
875 Hotels, Restaurants & Taverns	13.4 (27)	1.13	.83

Source: "Employment Earnings and Hours", D.B.S., Ottawa: Catalogue 72-002,
        December, 1972, pp. 16, 18, 20, 40, 42, 70, 72.

Footnotes

[1]This table is constructed from data which apply to the Vancouver
Census Metropolitan Area (CMA). This area is essentially the G.V.R.D. with
Bowen Island and Lion's Bay excluded.

[2]Parenthetical figures represent the per cent of Greater Vancouver's
total employment in a given industry subpopulation. In the case of primary
industries, only the total construction employment is used due to the
unavailability of data.

Table 3.VII   (continued)

[3]These location quotients are calculated by taking for each respective SIC group

> (Per cent of total Greater Vancouver's manufacturing employment in respective SIC group) ÷ (Per cent of total National manufacturing employment in respective SIC group).

[4]These location quotients are calculated by taking for each respective SIC group

> (Per cent of total Greater Vancouver's manufacturing employment in respective SIC group) ÷ (Per cent of total British Columbia's manufacturing employment in respective SIC group).

[5]Due to the secrecy provisions of the Statistics Act, provincial employment is not published for Insurance Carriers. Therefore, the location quotient is not calculable.

that the location quotient does not always provide a good estimate
of the economic base multiplier due to significant understatement of
export activities.

Table 3.VII suggests that wood products; saw, shingle, and
planing mills; and water transport and services are dominant in-
dustries in Greater Vancouver with respect to Canada. These wood
industries are merely distinctive industries in Greater Vancouver
relative to B.C. This indicates that B.C. is quite a specialized
province while Greater Vancouver is even more specialized in these
wood industries. Thus, Greater Vancouver's manufacturing structure
is oriented about primary resources. Metal fabricating industries in
Greater Vancouver are dominant relative to B.C.; distinctive relative
to Canada. This suggests that most of British Columbia's metal fabric-
ating is specialized in Greater Vancouver yet this degree of special-
ization is not very high in the Canadian context. Distinctive in-
dustries with respect to B.C. and Canada are: building; general con-
tractors; food and beverages; foods; department stores; communication;
and business services. British Columbia's insurance and real estate;
and special trade contractors are specialized in Vancouver but this
degree of specialization is below the national average. Hotels,
restaurants and taverns are distinctive industries in Vancouver relative
to Canada but Vancouver is unspecialized in this industry with respect
to B.C.

Further insight into Metropolitan Vancouver's economic base is
provided in Table 3.VIII. Although this table refers to selected
indicators of economic activity for B.C. in 1971, it is thought that
these Provincial statistics portray the context of Metropolitan

Vancouver's economic base. Table 3.VIII suggests that B.C. maintains
an export to import ratio of approximately two to one. Significant
increases in personal income over the past ten years have kept pace
with the (Vancouver) consumer price index. However, British Columbia's
unemployment rate is quite high at 8.7%. It is also evident that the
actual value of manufacturing production exceeds that of the primary
industries listed by a factor of four. Therefore, the economic base
of Metropolitan Vancouver resides in a financially strong economy
characterized by a relatively high unemployment rate and high actual
value of manufacturing production.

Table 3.IX provides some insight into the future of Metropolitan
Vancouver's economic base. Although this table considers the Lower
Mainland, most economic activity of this area comprises Metropolitan
Vancouver. The classification of construction as a secondary rather
than a primary industry is arbitrary and does not significantly alter
forecast results.

Table 3.IX indicates the present and forecasted trend of in-
creasing employment in the tertiary sectors and decreasing employment
in the primary and secondary sectors. In spite of decreases in primary
and secondary employment, productivity continues to increase in these
sectors. These trends prevail throughout the Canadian economy.[48] Given
the natural resources of the Vancouver Region, Metropolitan Vancouver's

> "...manufacturing has a strong processing emphasis with
> its fabrication geared to serving limited but growing
> domestic markets....Expansion of the region's manufacturing
> role will depend on growth of the regional market, in-
> creased manufacture of equipment for use in the province's
> expanding resource industries and the ability of producers
> to achieve technical superiority in innovating and pro-
> ducing for mass export markets."[49]

Table 3.VIII. Selected Indicators of Economic Activity
             British Columbia, 1961 - 1971

	Units	1961	1971	Increase 1961-1971
Population (mid-year)	'000	1,629	2,185	34.1
Employment (average)				
Total	'000	527	847	60.7
Manufacturing	'000	100	150*	50.0
Unemployed	% rate	7.5%	8.7%	
Personal Income				
Total	$ Million	3,003	7.900	163.1
Per Capita	$	1,843	3,616	96.2
Consumer Prices (Vancouver)	Index (1961 = 100)	100.0	127.0	27.0
Retail Trade	$ Million	1.604	3,632	126.4
Cheques Cashed	$ Million	20,434	64,994	218.1
Value of Production				
Agriculture (Farm Cash Receipts)	$ Million	135	221	63.7
Forestry (Logging, value added)	$ Million	**	395*	----
Mining	$ Million	180	527	192.8
Fishing (Landed Value)	$ Million	40	59	47.5
Manufacturing (Value of Factory Shipments)	$ Million	1,927	4,013	108.3
Electric Power Consumption	Million kwh	13,421	28,571	112.9
Gasoline Consumption	Million gal.	339	645	90.3
Overseas Trade through British Columbia Customs Ports				
Exports	$ Million	1,081	2,771	156.3
Imports	$ Million	422	1,340	217.5
Motor Vehicles Registered	'000	584	1,084	85.6
U.S. Passenger Cars Entering British Columbia	'000	448	1,167	160.5

*   Estimated
**   1961 not available due to change in reporting concept

Source: "Office Space Survey, 1972". This survey was conducted by Western
          Realesearch Corporation Ltd. for the Real Estate Board of Greater
          Vancouver in Real Estate Trends in Metropolitan Vancouver
          1972-1973   (Statistical and Survey Committee, Vancouver: 1972)
          p. D-10.

Table 3.IX   Percentage Distribution of Employment in the Lower
              Mainland* by Industry Group, 1951 - 1981

| | Actual*** | | Forecast Estimates | | | | Percentage Change in Employment (Rounded) 1971-1981 |
	1951	1961	1971	1981	2000 range	mean	
Agriculture	4.4	2.9	1.6	1.0			(65.5)
Extractive	4.3	2.8	1.4	.8			(71.5)
TOTAL PRIMARY	8.7	5.7	3.0	1.8	1-2	1.5	(68.5)
Manufacturing	24.0	18.9	19.0	19.0			.5
Construction	7.1	6.8	6.8	6.8			no change
TOTAL SECONDARY	31.1	25.7	25.8	25.8	22-26	24	no change
Transportation Group	11.4	11.4	11.6	11.6			1.75
Trade	19.2	19.5	19.5	19.5			no change
Finance Group	4.2	5.1	5.5	5.5			7.4
Services****	24.0	23.3	24.9	25.9			12.1
Public Administration	1.4**	9.3	9.7	9.9			6.5
TOTAL TERTIARY	60.2	68.6	71.2	72.4	72-77	74.5	5.5

Notes: *   Census Division 4, B.C.
         **   Public administration grouped with "Service" until 1961
         *** 1951 and 1961 Census not strictly comparable due to SIC
              revisions and introduction of the "New Establishment
              Concept."
         ****Community, business and personal service industries.

Source: Space for Industry, G.V.R.D. Planning Department, Dec.1970, p. 1.

The service sector is expanding to accommodate the increasing regional market and British Columbia's resource development. Therefore, Greater Vancouver is becoming the financial and management centre of Western Canada.[50]

C. Intrametropolitan Location of Business Sectors in the G.V.R.D.

Offices

Any discussion of the intrametropolitan location of various firm categories must consider the location of offices because all sectors, to some extent, locate in offices. Since the various sectors have a different theoretical basis for their intrametropolitan location, an intrametropolitan location theory for office space is very complex. Office location is further complicated by the inability to quantify inputs and outputs of the office production function. Output, for example, is unstandardized for a given firm as well as its competitors. Moreover, Hoover and Vernon suggest that the precise measurement of costs and benefits which accrue with spatial variation of the production function is uncertain for offices. For example, improvements in executive work quality at a specific location and the increased operating costs to locate there are immeasurable.[51] Therefore, there is no major intrametropolitan, office location theory available.

It is noted, however, that in order to overcome spatially contingent costs and benefits, offices generally require a C.B.D. location to attain interdependence and take advantage of external economies. Firms which locate centrally usually require the opportunity to easily collaborate on a personal basis with other organizations.[52] Moreover, Fisher suggests that the advantages of a peripheral location, i.e.

lower land costs, a good working environment, etc., have little effect on the decision to locate offices.[53] Metropolitan Vancouver is no exception to these general observations.

Figure 3.IV shows the principal office building locations in the G.V.R.D. Note the axial arrangement along the Hastings, Kingsway and Marine Dr./Lonsdale corridors. This pattern evolved over the past 40 years as development and zoning reinforce and stabilize each other.[54] The location of offices on main transportation links also enables easy spatial interaction whence personal encounters.

Metropolitan Vancouver's office space grew from 11.9 million square feet in 1971 to 12.9 million square feet by 1972. Vancouver increased its office space from 10.9 to 11.7 million square feet from 1971 to 1972; approximately 8 million square feet presently occupy the C.B.D. Most of this growth occurred along Kingsway and East Hastings. Suburban office space exclusive of Vancouver comprises 1.27 million square feet. Richmond, Burnaby, and North Vancouver city experienced the highest growth rates; little growth occurred in West Vancouver.[55] Appendix II summarizes the size of principal non-government buildings.

Primary Industries

The intrametropolitan location theory of primary industries is significantly developed by von Thünen. As previously mentioned, von Thünen fully developed the rent concept to suggest that, ceteris paribus, intensity of agricultural land use decreases as distance from the central market increases due to the increase of transportation costs. Game theory models further develop von Thünen's framework. However Gregor suggests that,

Figure 3.IV   Greater Vancouver Regional District: Principal Office
                Building Locations, 1972.
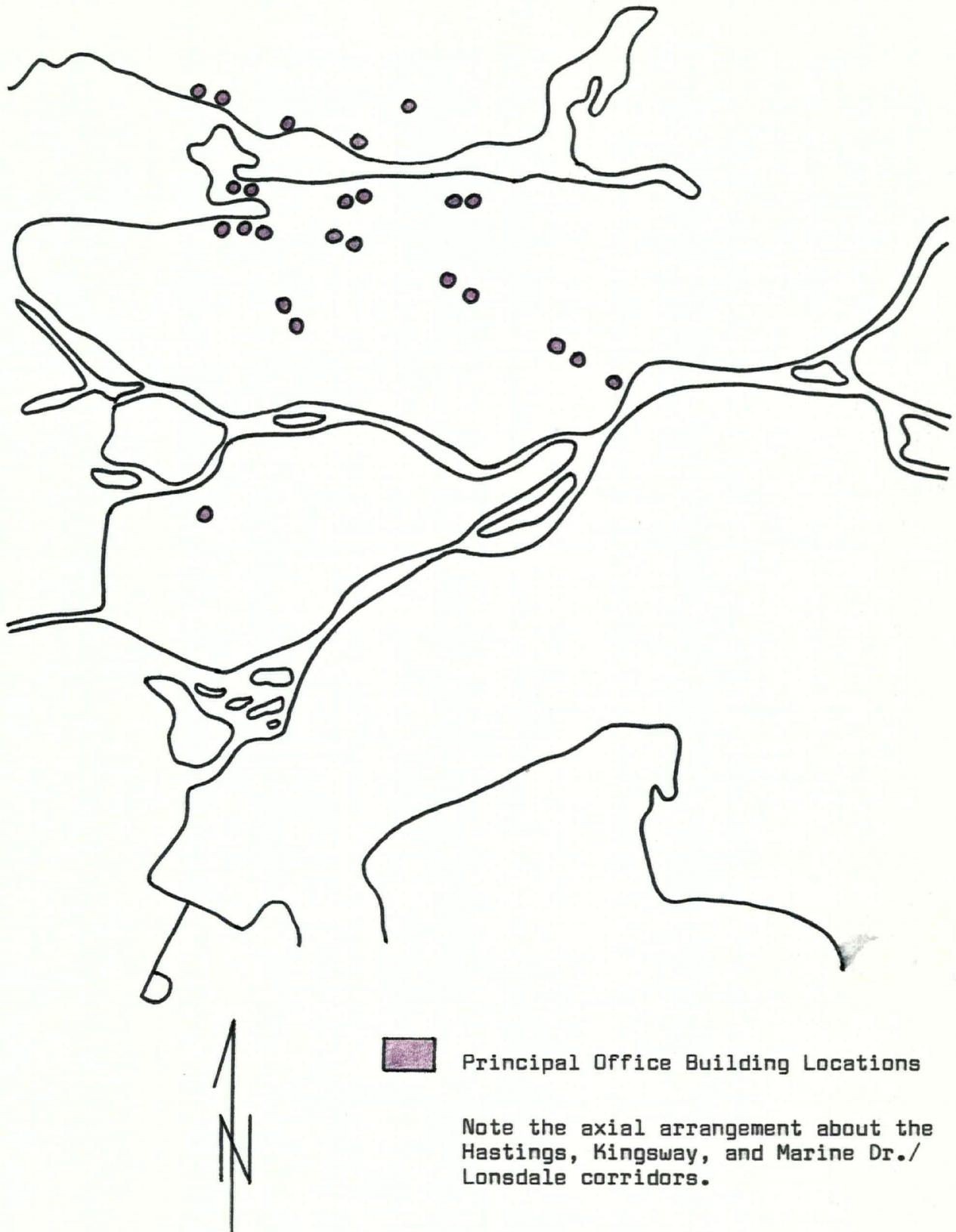
Principal Office Building Locations

Note the axial arrangement about the
Hastings, Kingsway, and Marine Dr./
Lonsdale corridors.

Source: "Office Space Survey, 1972".   This survey was
          conducted by Western Realesearch Corporation
          Ltd. for the Real Estate Board of Greater
          Vancouver.   In Real Estate Trends in Metro-
          politan Vancouver 1972-1973, (Vancouver, Canada:
          Statistical and Survey Committee) p.C-5.

"Game theory still cannot completely enlighten us on
the decision-making process, however, for it operates
on several assumptions that are untenable in an actual
situation. The two most objectionable of these are that:
(1) decisions are made solely on economic grounds
     and with a desire for optimum solutions; and
(2) all existing information about market opportunities
     and technology is uniformly available and acceptable
     to the decision maker."[56]

Game theory can, however, deal with the locational constraint of re-

source availability. The limitation of these theories is that they

best apply to agriculture; not all primary industries.

From the above, it is expected that more intensive farming

occurs as near as possible to the C.B.D.; commercial fishing operations

locate on the waterfront where break of bulk occurs. However, primary

firms such as forestry or mining do not locate within a city on the

basis of resource availability or transport cost of output. They

locate in offices in the central core. This study classifies construc-

tion firms under the primary sector. The intrametropolitan location

of construction firms, however, is probably best explained by the

theory of intrametropolitan industrial location. Therefore, there is

no major intrametropolitan location theory applicable to primary in-

dustry in the G.V.R.D.

Figure 3.V shows the areas of actual agricultural land use in

the G.V.R.D. for 1970. Approximately 80% of this agricultural land is

south of the Fraser River.

In 1966, the Lower Mainland[57] had 256,235 acres of total farm

area of which 202,096 acres are improved. Total farm area shows steady

decline from 330,259 acres in 1941 while improved land area only

slightly increased.[58] This is due to the encroachment of other land

uses onto farmland.

Figure 3.V   Greater Vancouver Regional District: Actual
              Agricultural Land Use, 1970.

Agricultural

N
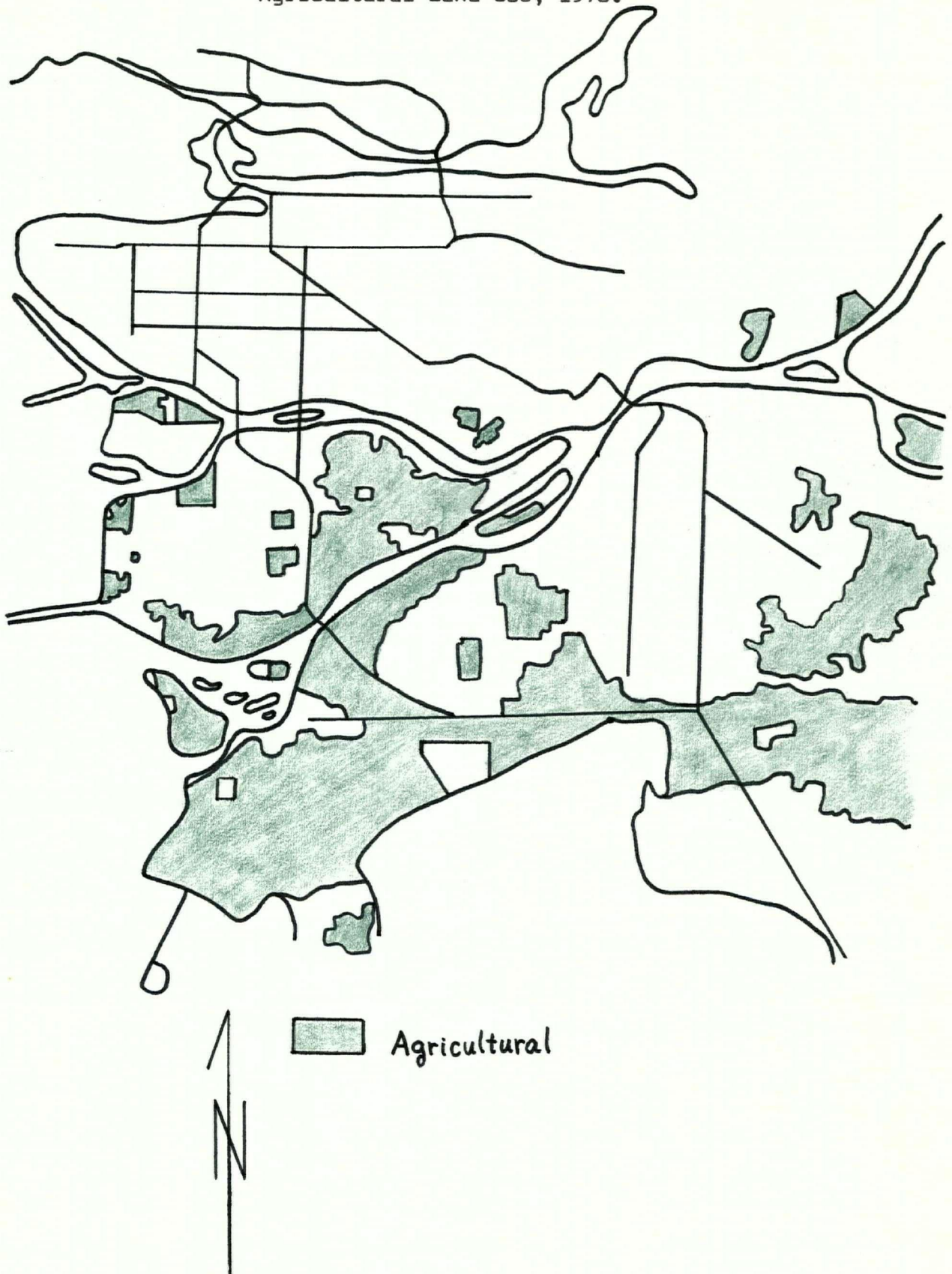
Source: "Existing Development, 1970:
           (Map K21-020), Planning Department,
           January, 1970.

0 1 2 3
Miles

Although approximately 10% of total primary employment (includes construction, please see Table 3.IX) in the Lower Mainland is presently in agriculture,[59] employment is expected to decrease with technological improvements.

As previously suggested, mining and forestry firms are located in offices of the central core (Figure 3.IV). Location of construction firms is implied in the proceeding discussion of manufacturing firms.

Manufacturing Industries

M. A. Goldberg's[60] work is the first theoretical enquiry into the intraregional location of manufacturing. It is shown that the properties of the generalized production function (GPP) help explain city size, whence industrial location. The GPP is consistent with empirical observations for industrial location, includes extensions to more than two variables and to variable elasticities of substitution, and considers the effect of scale of output on internal economies as well as size. The class of GPP's is defined by: $V = g(f)$ where $\frac{dg}{df} > 0, \forall f, 0 \leq f \leq \infty$ and g is a transformation function such that: $V = g(o) = o$ and

> f = a neoclassical production function with ≥ 2 inputs

> V = units of real output per time unit.

With the GPP, returns to scale and scale itself are functions of location. Optimality criteria for inputs and location are derivable for general and specific functional forms. However, while each firm locates rationally from its viewpoint, locational behaviour is random from the aggregate point of view. This random behaviour allocates firms over the equally likely sites of the subset of feasible sites.

The empirical evidence, from which the GPP is consistently derived, suggests a theory of intrametropolitan industrial location. Raymond Vernon observes that industries which usually require central locations are found to have the following traits:

1. They have unstable output due to volatile demand, seasonality or product demand.

2. They require speed of communication and transmission of ideas amongst several, varied functions external to the firm in order to derive the firm's output.

3. They require face-to-face contact.

Whenever these industries locate outside central areas, they tend to be larger than their counterparts who locate in the C.B.D. Industries which usually locate peripherally are found to have the following characteristics:

1. They are transport-oriented plants which desire to avoid central congestion and move large quantities of inputs and outputs.

2. Their large scale production requires more space than provided in the central areas.

3. They are rapidly expanding industries who anticipate plant expansion and require cheap land.

Therefore, the hypothesis that smaller plants of a given industry generally locate centrally while larger plants of the same industry generally locate peripherally,[61] is sustained by Goldberg's work. Depending on how the sample is stratified, the hypothesis that plant growth is limited by the space constraints of the plant-size is either supported or refuted. No conclusion can be drawn concerning the hypothesis that growing plants move in general, and in particular that they move to less dense subareas of the urban region. There are, however, sufficient weaknesses in the data to discredit any estimates based upon it.[62]

In the following discussion, references to industrial land include manufacturing (SIC 200-399); construction (404-439); transportation, storage and communications (514-549); and wholesale (701-729) groups.

Figure 3.VI shows the zoning constraint which influences intra-metropolitan industrial location in the G.V.R.D. The supply of industrial land can always be extended with zoning and is by no means fixed. Approximately 20% of zoned land is actually under industrial use in Figure 3.VII. This is partially explained by Figure 3.VIII where land under actual industrial use coincides with critical infra-structure linkages; less suitable industrial zoned sites to a lesser degree. Moreover, about 50% of the industrial survey districts have difficult foundation conditions. Such conditions are unsuitable even for light industry. Figure 3.IX shows those areas which can be re-claimed for industrial use.

Table 3.X shows the number of acres used by various sectors in Metropolitan Vancouver. Manufacturing by far occupies the largest portion of land: 5,405.8 acres from a total industrial acreage of 7,308 acres.

Table 3.X. Use of Industrial Land - Metro Vancouver 1966

Manufacturing	5,405.8 acres
Construction	161.3
Wholesaling	778.9
Transportation, communication and storage	⟩ 962.0
Total Industrial Acreage	7,308.0

Source: <u>Space for Industry</u>, G.V.R.D. Planning Department, 1971, p. 13.

Therefore, Figure 3.VII predominantly shows manufacturing locations.
Table 3.XI and Figure 3.VII suggest that most of the industrial acreage
is in the municipalities of Vancouver and Burnaby. Of the approx-
imately 11,500 acres of developed industrial land in the G.V.R.D. in
1969, Vancouver, Burnaby, Richmond and Surrey each contain approx-
imately 2000 acres. Manufacturing firms occupy approximately 35% of
the total industrial acreage in Vancouver and Burnaby. Table 3.XII
further suggests that smaller manufacturing firms occupy central
locations while larger manufacturing firms locate peripherally.

Table 3.XI. Acreage of Industrial Development[1] - 1966

Area	Developed Sites	No. of Firms	Acres Occupied
Vancouver	1,396	1,897	1,791
Burnaby	353	462	1,594
New Westminster	122	159	395
Coquitlam	16	20	530
Port Moody	15	15	647
North Vancouver City	68	104	185
Delta	57	65	245
Richmond	176	215	787
Surrey	121	137	450
Total Metro Area	2,324	3,074	6,624

[1]Includes Manufacturing (SIC 200-399); Construction (404-439);
Transportation, Storage and Communications (514-549); and Wholesale
(701-729) groups.

Source: Space for Industry, G.V.R.D. Planning Department, 1971, p. 8.

Figure 3.VI   Greater Vancouver Regional District: Zoned
               Industrial Areas, 1970.

■ Areas Zoned Industrial

N

Source: Space for Industry, G.V.R.D. Planning
         Department, 1971, pp. 9,10.

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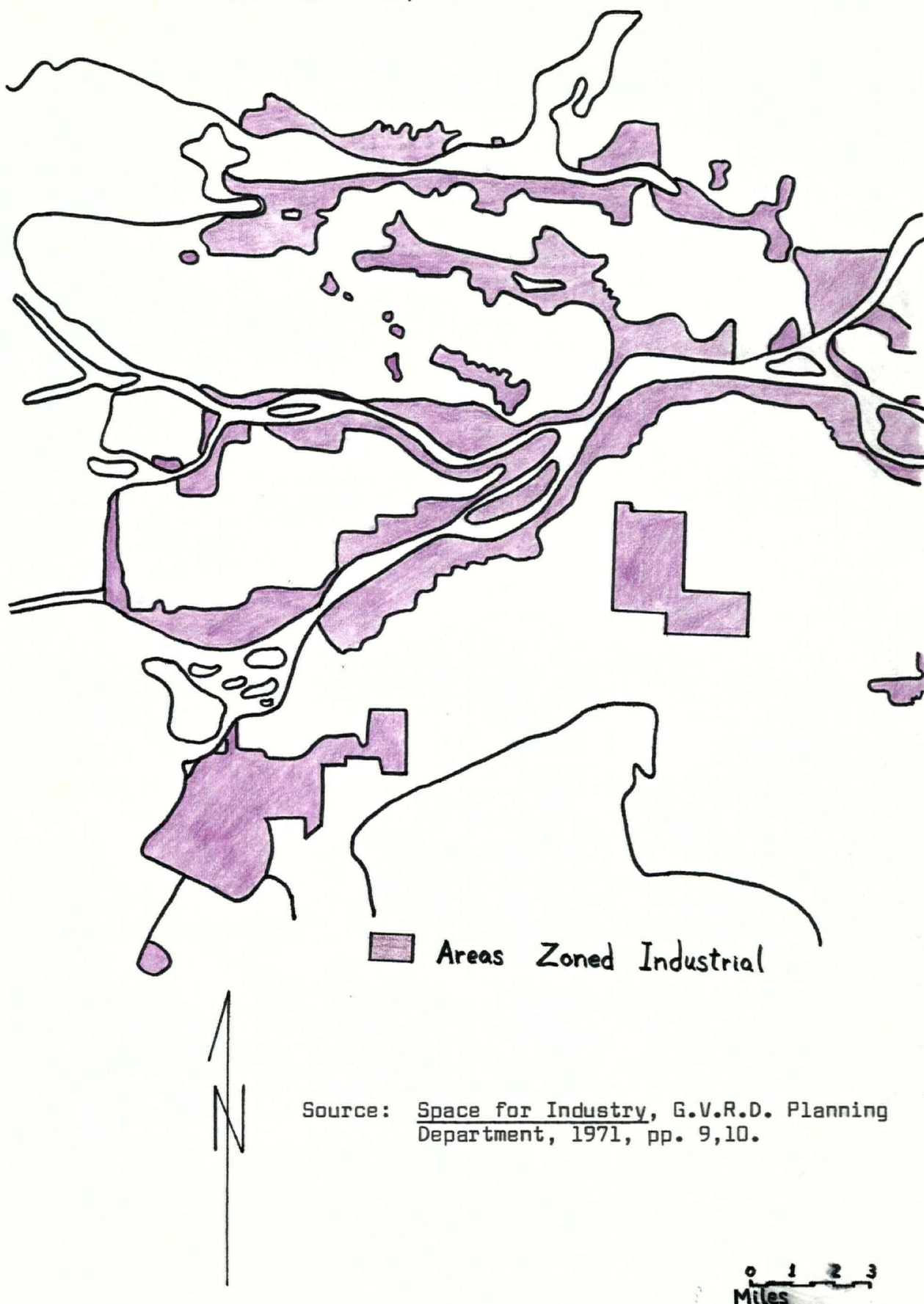
Figure 3.VII   Greater Vancouver Regional District: Actual
                Industrial Land Use, 1970.

▦ Areas under Industrial use 1970

Source: "Existing Development, 1970"
           (Map K21-020), Planning Department,
           January, 1970.

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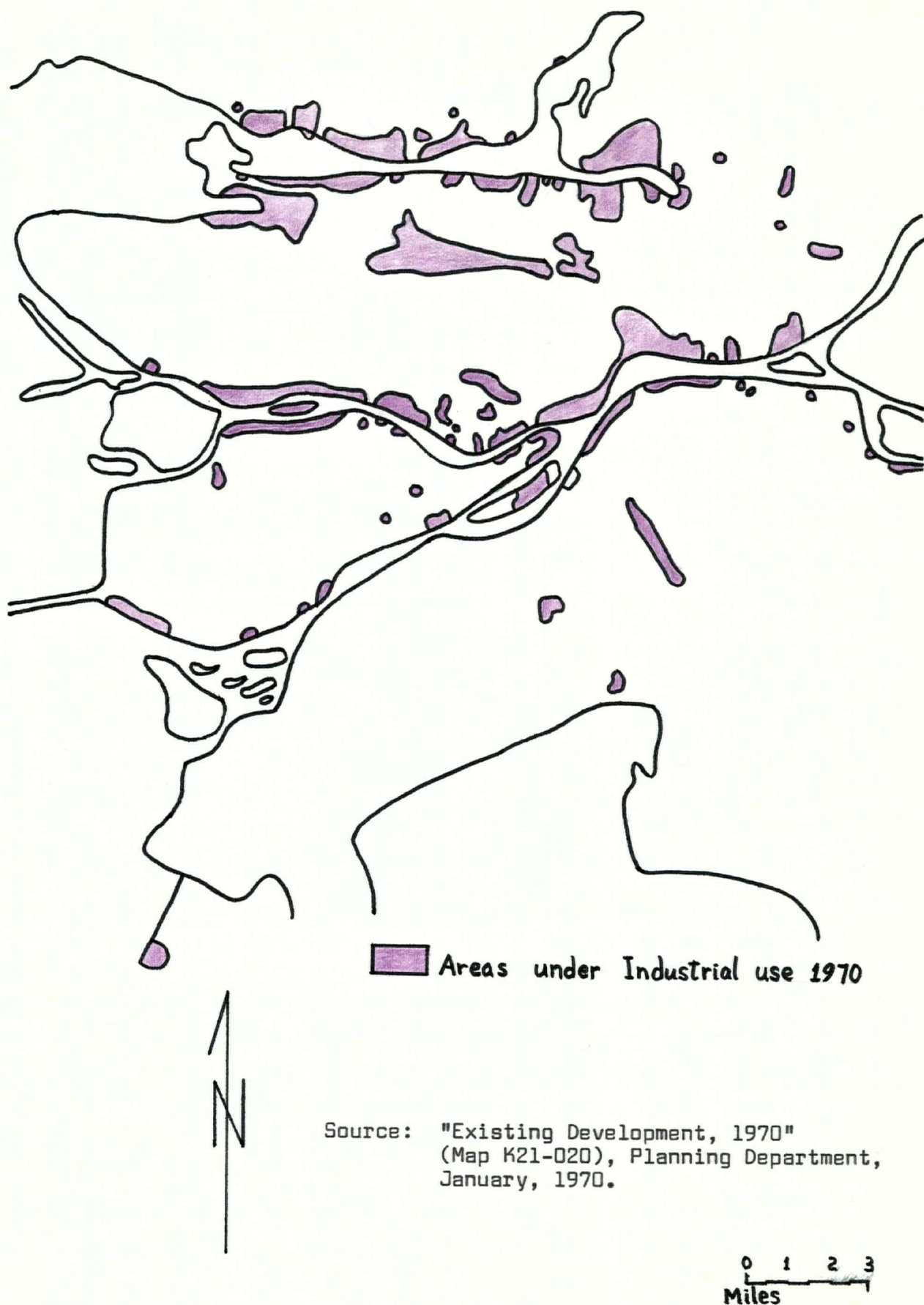
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Figure 3.VIII   Greater Vancouver Regional District: Industrial
                 Location Determinants, 1970.

Legend:

— Roadway
+++++++ Railroad
''''''''''' Deep Water Channels
Difficult Foundation Conditions
Industrial Survey Districts
Steep Slope
Industrial Survey Districts with Foundation Difficulties
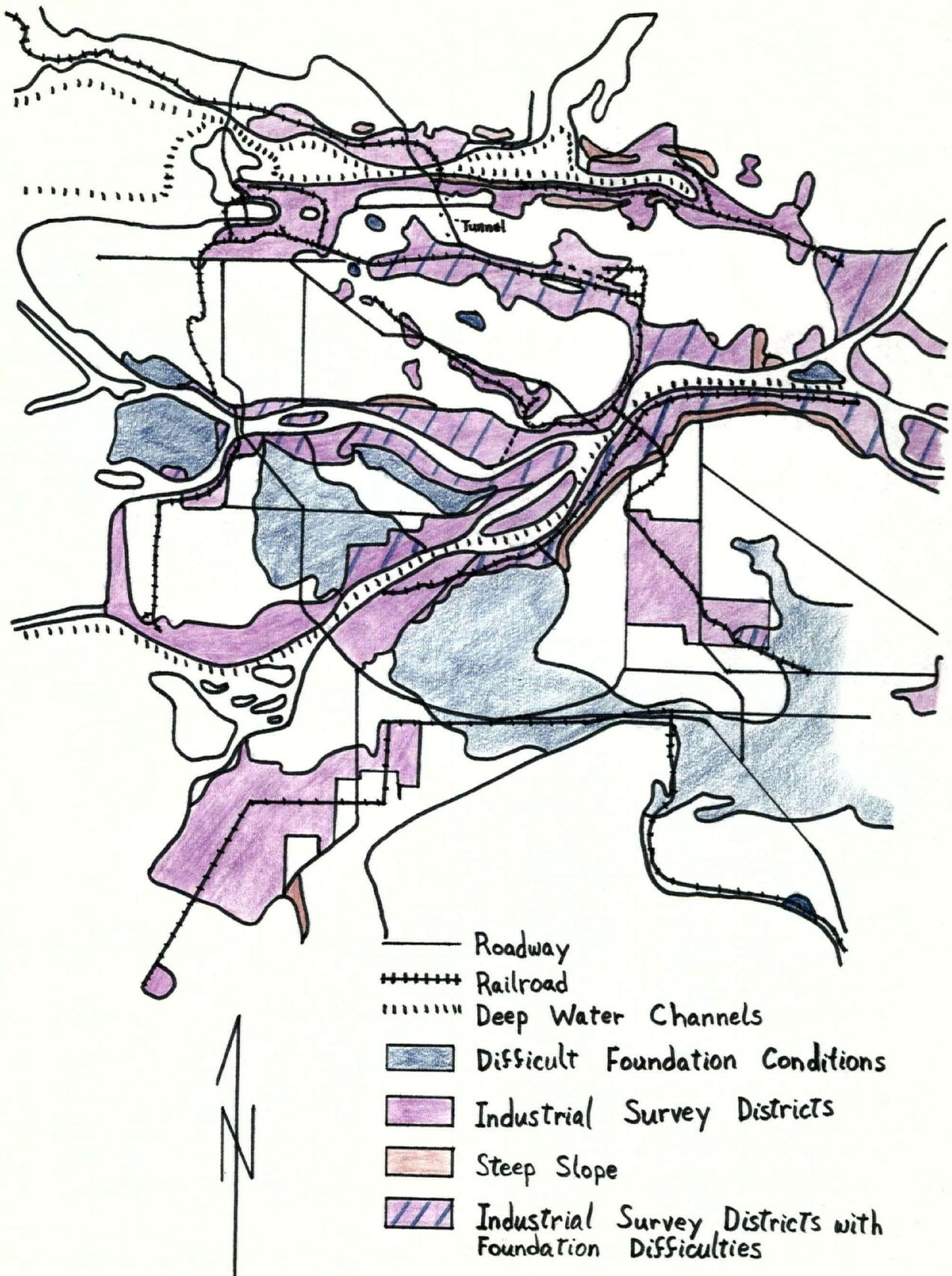
Source: Space for Industry, G.V.R.D. Planning
         Department, 1971, pp. 5-6.

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Figure 3.IX   Greater Vancouver Regional District: Industrial
Areas of Potential Use, 1970.

Prime Land:
Major Areas: Vacant, suitable and available

Areas Requiring Sandfill

Industrial Parks
Expansion Areas:

Potential Reclamation of Tidal Lands

Reclamation of Peat Lands

Other Expansion
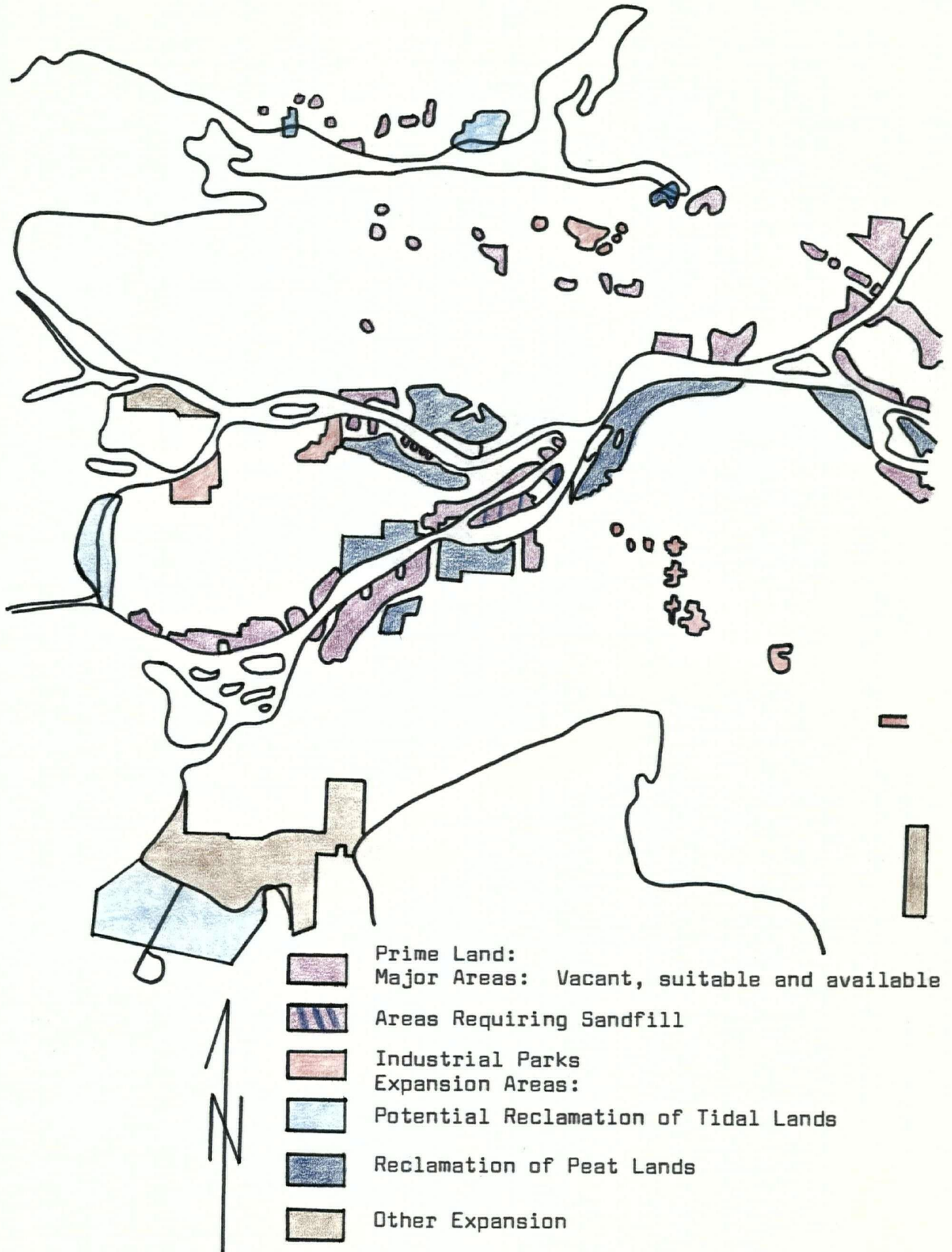
Source: Space for Industry, G.V.R.D. Planning
Department, 1971, pp. 21-22.

0   1   2   3

Miles

Table 3.XII   Average Density of Industrial Development and Average
Site Size of Industrial Firms, 1966.

Municipality	Density (Firms/Acres)	Average Site Size (Acres)
Vancouver	.78	1.3
North Vancouver City	.37	2.7
New Westminster	.31	3.2
Surrey	.27	3.7
Delta	.23	4.3
Burnaby	.22	4.5
Richmond	.22	4.5
Coquitlam	.04	22.7
Port Moody	.02	43.2

Source: Space for Industry, G.V.R.D. Planning Department, 1971, p. 45.

Retail Trade

An intrametropolitan retail location theory is outlined by the
central place theory of the previous chapter.

Figure 3.X shows the actual commercial land use in the G.V.R.D.
for 1970. Commercial development includes all retail as well as some
financial and administrative service firms. Much of this commercial
land is in the form of strip development along the Hastings and
Broadway/Kingsway corridors. Appendix II presents the amount of
commercial floor space of various commercial centres in the G.V.R.D.
for 1970. Approximately one-third of Metropolitan Vancouver's com-
mercial floor space is in Vancouver.

Figure 3.XI shows existing commercial areas and commercial
zoning in Vancouver with a Christallerian marketing hierarchy of central

Figure 3.X Greater Vancouver Regional District: Actual Commercial
Land Use, 1970.
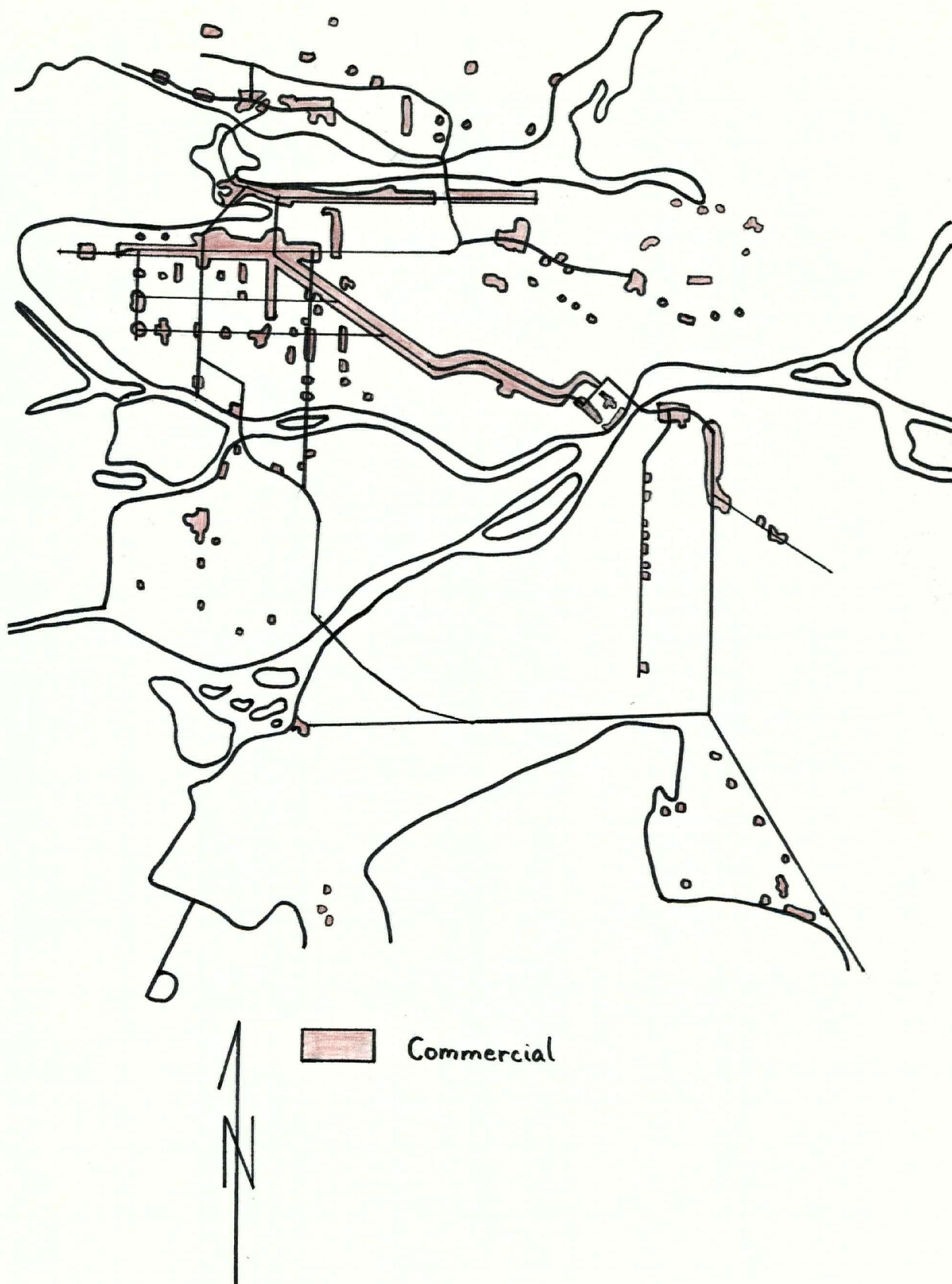
▨ Commercial

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0 1 2 3
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Figure 3.XI   Vancouver: Existing Commercial Areas and
              Commercial Zoning with a Christallerian
              Marketing Hierarchy of Central Places, 1972.

Local Function
Commercial Zones Areas
District Function
Regional Function
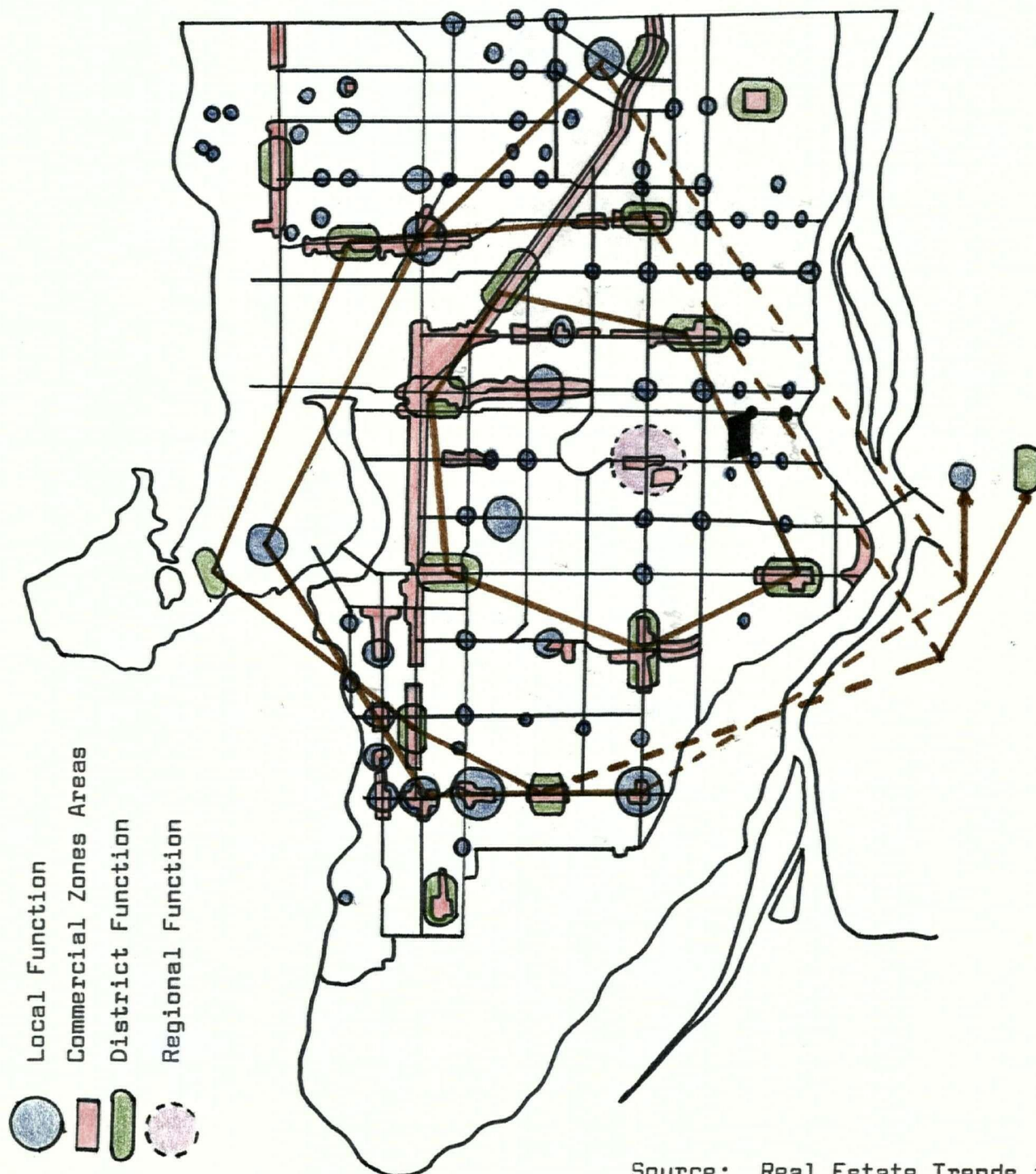
Source: <u>Real Estate Trends in
         Metropolitan Vancouver
         1972-1973</u> (Vancouver:
         Statistical and Survey
         Committee, 1973) Plate 1,
         (Appendix)

places. Note the very striking hexagonal market array of district
functions about the regional function of Oakridge. The hexagonal
market areas are imperfectly formed due to zoning which is mainly
constrained by irregular geography, i.e. waterways, hills, etc., and
a non-uniform population distribution. No well developed retail
centre, for example, exists on the University Endowment Lands due
to the relatively low density and transient population. Alternatively,
Oakridge would be more geographically central to its district functions
if Queen Elizabeth Park did not exist. Therefore, the resultant
hexagonal pattern of retail functions in Vancouver is somewhat ex-
plained by central place theory.

Wholesale Trade and Storage

An intrametropolitan location theory for wholesale trade
remains quite undeveloped. This is because wholesalers perform rela-
tively high order spatial functions with respect to inputs and outputs.
It consists of business transactions which do not necessarily involve
ultimate customers and can occur in an abstract fashion. These trans-
actions can also involve external influences to enable exogenic
change.[63] Vance therefore suggests that,

> "No longer...(are)...neat assumptions as to how far
> and in what scale trade...flow...(is)...possible.
> Even the total size of trade...(cannot)...be pre-
> determined, because no valid bounding line, short of
> the total world,...(is)...self-evident. Without the
> determinate qualities of retail trade, wholesaling...
> (is)...not amenable to analysis under any theory founded
> upon endogenic change."[64]

Consequently, tools of analysis such as scale of trade are unusable to
develop a location theory. Analysis of wholesalers, whether theoretical
or empirical, is further plagued by the problem of definition because
several firms claim to sell at wholesale prices. It is also difficult

to unravel the present integration of manufacturing, wholesaling, and retailing activities.[65]

In the absence of a rigorous theory, the taxonomy of the wholesale function in urban areas has been observed. Vance and Ratcliffe suggest that the location of the old warehouse districts adjacent to the central retail district depended upon the specific mode of the original transport medium.[66] Vance further states that,

> "...Great importance is attached to the distinction
> between customer access and supply of goods access.
> If supply of goods dominates the location decision,
> then technological changes will have greatest effect
> on the location decision, and we may find during
> the course of the city's history several rather different
> sites that have been used by a single wholesaling firm,
> with one toward the periphery standing as the present
> home. In contrast, when customer access dominates,
> locational shift will be less common, for the simple
> reason that customers and their transport have
> changed less in the course of urban history than has
> the handling of goods."[67]

Consequently, the following wholesale districts, based on some combination of supply of goods and customer access, evolve:

1. The Produce District: Vegetable dealers locate in this district which is adjacent to the shopping district. This enables ready customer access. This district is disappearing from cities due to the encroachment of offices which restrict access for both producers and consumers.

2. The Product Comparison District: This district often occurs adjacent to the C.B.D. where out of town buyers stay in hotels. Thus, buyers can readily comparison shop in this district. Clothing and furniture wholesalers cluster here as a sales strategy.

3. Will-Call Delivery District: Wholesalers located here deal with items that possess timeliness. Phonograph records, appliances and auto parts are examples of such items. This district is located in the C.B.D. such that it has good access to the internal metropolitan highway system. Retailers, who generally possess a minor stock of such items, can readily supplement their inventory as the need arises.

4. Manufacturing Stocks District: These wholesalers require ready customer access. Paper dealers, for example, sell a

standard item to diversified printing manufacturers. Due to
the heavy paper demand from commercial and office activities,
paper wholesalers locate close to printers who in turn
locate near the city core. Textile wholesalers to the
garment industry are a further example. Characterized by
time pressure on production, volatile demand, several small
manufacturers, and a shortage of working capital, garment
manufacturers and their wholesalers tend to locate
centrally.

5.   The Office Wholesaling District: Various wholesalers require
        an office district location in order to deal in the title
        to goods rather than their physical handling. These agents,
        brokers, etc., require face-to-face dealings, often with
        respect to market price.[68]

The above wholesale districts are intimately associated with

the C.B.D. However, Gottman notes the tendency for some wholesalers

to require large warehouses with good accessibility, particularly for

trucks. Since these requirements are not easily found with the ex-

pensive and congested land of the urban core, peripheral sites are

chosen.[69] Therefore, the wholesale function is distributed both centrally

and peripherally over urban areas.

Since Metropolitan Vancouver is a break of bulkpoint between

land and sea transportation, it serves as an ideal entrepôt for wholesale

activity. Figure 3.V includes the location of wholesale trade and

storage firms which occupy approximately 780 acres in Metropolitan

Vancouver. Prime wholesale districts are found along the Fairview Slope

from Main to Granville Streets and the west end of False Creek to

Burrard Street. These areas are in close proximity to the C.B.D.

Development of warehouse facilities has significantly increased over

the past three years. Consequently, the establishing areas of Clark

Drive, Powell Street, Boundary Road, Lougheed and S.E. Marine Drive

are also well established, given their increased accessibility to other

sectors of Metropolitan Vancouver.[70]

Infrastructure

The intrametropolitan location of infrastructure activities
appears to be based upon central place theory, given geographical
constraints and population densities. This excludes the location of
head offices which, of course, are founded upon office location
considerations. It is assumed that infrastructure firms further choose
a location via cost benefit analysis. Cost benefit analysis can only
realistically be used by non-office, private sector firms where
optimization against measurable criteria such as profits is feasible.
Taxicab or moving and storage companies, for example, would find cost
benefit analysis useful in the choice of a location. Since public
works projects promote the efficiency of private economic and social
activities, there is a problem to allocate scarce funds on the basis
of sensible and consistent criteria of project worth. Economists
generally subscribe to the theoretical soundness of cost benefit analysis
as an appropriate tool for the location decision of public works. In
reality, the method is costly to implement and yields questionable
results. Evaluation of project worth is exceedingly difficult, partly
because it is difficult to foresee the consequences of such projects and
partly because it is hard to appraise their social values. Cost benefit
analysis is essentially a variant of the income approach to value.
Realistically, the assets, and their concommitant location, must be
considered for decision making purposes. In other words, supply with
respect to demand rather than demand per se for urban infrastructure in
the public sector must be considered in order to decide how to upgrade
the real value of a given inventory.[71] Therefore, the location of
public infrastructure firms via cost benefit analysis is inappropriate.

The location of public infrastructure firms is also more restricted than central place theory suggests. Manners states that,

> "...There is a...labyrinth of influences moulding the... (location)...patterns of energy...(i.e. electric power, gas and water utilities)...These forces -- economic and social, political and historical, technical and, at times fortuitous -- are all intimately related to each other..."[72]

Therefore,

> "Any empirical survey of the various factors which are involved in the location of secondary[73] energy production quickly reveals the complexity and variety of locational choice, and underlines the individuality of each case."[74]

The location of infrastructure firms in the G.V.R.D. is shown in Figure 3.X as well as Figures 3.IV, 3V and 3.X. In Figure 3.XII, note the diffuse pattern of civic and institutional land uses which serve most points in the G.V.R.D.

Financial and Administrative Services

No single theory comprises the intrametropolitan location of financial and administrative services. Financial services usually locate on the basis of office location considerations. Theatres, for example, utilize central place theory. Some government services utilize public infrastructure considerations in their location decision. Therefore, a diverse spatial arrangement of Metropolitan Vancouver's financial and administrative services ensues in Figures 3.IV, 3.X and 3.XII.

Figure 3.XII Greater Vancouver Regional District: Actual
Civic and Institutional Land Use, 1970.

Civic and Institutional

N
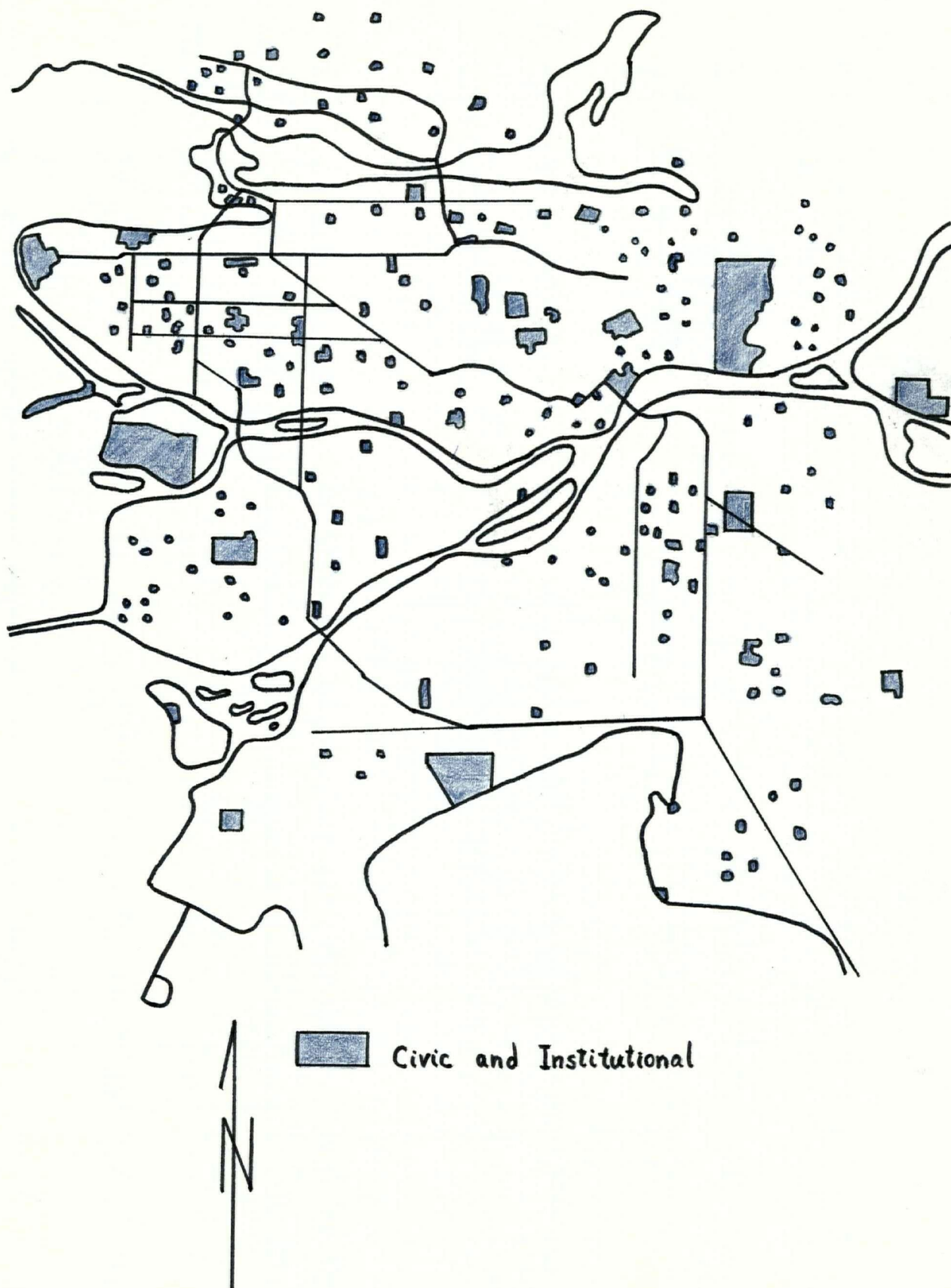
Source: "Existing Development, 1970"
(Map K21-020), Planning Department, G.V.R.D.,
January, 1970.

0 1 2 3
Miles

D. Summary

This chapter presents an historical, economic and business
sector synopsis of metropolitan Vancouver. The synopsis outlines
some topics which are relevant to the present location/relocation,
questionnaire study of firms located in the G.V.R.D. This spatial
context of the questionnaire study hopefully enables interpretation of
the questionnaire data. The following chapter specifically considers
the questionnaire study. In particular, the present study is con-
sidered in the context of the IIPS study. Discussion of the question-
naire technique and the specific variables used in the present study
are a prelude to the statistical analysis of the questionnaire data.

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[71]The author wishes to express his sincere thanks to Professor W. F. Smith for the idea of using real stock variables to locate public infrastructure firms.

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[73]Primary energy is used to produce an alternative and more convenient, secondary form of energy. Transport costs only influence the total cost but not the location of a primary energy source. With secondary energy sources, which are more pertinent to the intra-metropolitan context, transport costs influence the total cost of the energy as well as the location of the conversion from a primary into a secondary energy form.

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CHAPTER IV

THE PRESENT QUESTIONNAIRE STUDY

A. Introduction

The purpose of this chapter is to consider the location
questionnaire survey in the context of the IIPS study. Discussion of
the questionnaire technique and the specific variables used in the
present study are a prelude to the statistical analysis of the
questionnaire data. In particular, the feasibility to use the
questionnaire variables in both an inter-regional and intrametropolitan
location study is established.

B. The Inter-Institutional Policy Simulator (IIPS) Study

Perloff notes that urban planning has evolved into a very com-
plex practice from a field essentially concerned with aesthetics.
Planning now encompasses: engineering fields to enable efficient oper-
ation of urban components; land use control within the scheme of a
rational land use pattern; and socio-economic, political and physical
considerations which enable proper development and operation of an
urban area.[1] Planning further comprises land acquisition programs,
ecological controls and special research programs.

The IIPS project, which is a large-scale, special research
study of the G.V.R.D., demonstrates the complexity to which urban
planning has evolved. The University of British Columbia, the City of

Vancouver, the Greater Vancouver Regional District, the Department

of Municipal Affairs, the Province of British Columbia, and the

Ministry of State for Urban Affairs are jointly engaged in this program.

There are three goals for this program. The first goal is to construct

a simulation model[2] building process. Thus, a more refined model

evolves due to continual improvement and updating. The second goal

is to attain inter-institutional cooperation. This provides the

practical experience of the government levels required in the application

of recent research developments to the Region's practical needs and

problems. IIPS third goal is to create a model which considers real

world problems of interest to both private and public decision makers.

These sectors require total accessibility to a comprehendable model

which is economical to operate. Without the general use of the model

from both private and public sectors, modifications with respect to

reality are undesirably precluded.[3]

IIPS is designed for general use by the public; university

researchers, all levels of government and private individuals will have

access to the model. None of the output of the IPPS model is con-

fidential. Only profit-making corporations will be charged a users fee.

This fee covers development and running costs, subsidizes the use by

individual citizens and maintains a service staff to implement clients'

requests and explain the results.[4]

In order to study something as broad and complex as the G.V.R.D.,

the IIPS project is organized into nine modelling sub-groups and a

data collection and a data management group. The nine modelling sub-

groups consist of five groups critical to the IIPS modelling activity:

population, economics, transportation, land use, and local government.

Four other groups are also being developed: health systems, pollution, human ecology, and facilities cost.[5]

The economics group is responsible for the Vancouver Metropolitan Input-Output Study (VMIS) which will enable present and future analysis of the structure of the Vancouver Metropolitan Area economy. Figure 4.I shows a production distribution system of the six industry subpopulations in the present study as well as the household sector. The VMIS determines the sales and purchase relationships of the production distribution system in order to construct a 27 sector input-output matrix of the Metropolitan Vancouver economy. (Note that more than one sector can comprise a given industry subpopulation.) From this information the interdependence of the area's industries and their relationships with households and governments may be established.

Figure 4.I.   A Production Distribution System of the G.V.R.D.
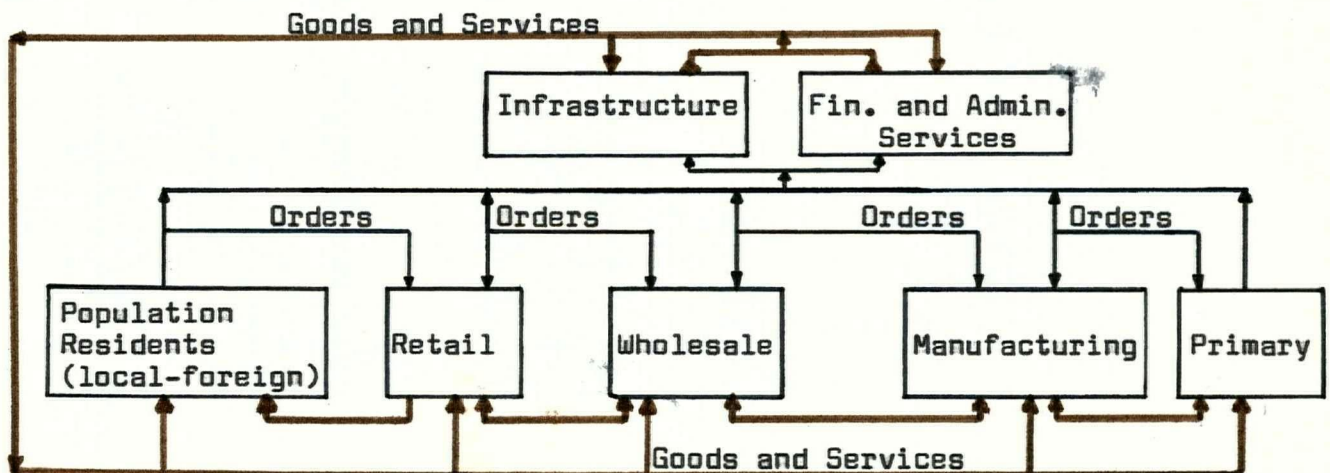
Input-output analysis[6] overcomes the disadvantages of other
methods which measure economic base because it acknowledges that an
urban economy is a matrix of firms trading with each other as well as
with the consuming public and the outside world. Firms which supply
to local export firms are proportionately considered as export firms
because the number of export jobs increases in several interrelated
industries whenever the export demand of one firm increases. The
increments of these industries are in different proportions; the effect
upon the community is different if increased export sales occur to
Firm X rather than Firm Y. Therefore, the detailed consequences of
export expansion or contraction in various firms of a region's economic
base, help determine appropriate urban economic policies.[10]

In particular, the location survey questionnaire was to be used
in conjunction with the Input-Output questionnaire. The location survey
questionnaire measures the level of importance of nineteen factors in
a firm's actual decision to locate in the G.V.R.D., as well as a firm's
hypothetical decision to relocate outside the G.V.R.D. The Input-Output
questionnaire requests precise revenue/sales and expenditure by spatial
sector in order to construct an input-output matrix. The SIC number,
sector, number of employees, and street address are known for both
questionnaires. Thus, wide scope for statistical analysis is possible
with both questionnaires.

Meagre response was unfortunately received for the Input-Output
questionnaire. Presumably, firms were reluctant to divulge extremely
confidential information for the public good. Thus, the location
survey questionnaire is presently of limited utility to the economics
group.

The land use group, however, will find the location survey questionnaire results useful. This group is developing models to allocate economic and residential activities across the Region. Emphasis is upon the development of rigorous housing models to assess the impact of all levels of government policies on the supply and demand for regional housing. However, the statistical analysis and regression models of the present location survey questionnaire study, provide an empirical data base for the land use group in their development of models which allocate economic activities across the Region.

C. Questionnaire Technique

The empirical data base for this thesis consists of 300 returns of the location survey questionnaire like that of Figure 4.II. 3800 firms representative of the Region's economic base were contacted such that the largest, i.e. most employees, firm was contacted together with a random sample of remaining firms in each industry sector. Thus, a larger portion of the economic base in terms of labour inputs, as well as a cross section of large and small firms, was probably surveyed than if the sampling procedure was totally random.

By February 1973, only 300 usable responses to the location survey were received. Approximately 20 responses were unusable due to insufficient information with respect to answering the questionnaire, sector number or location. This represents a total usable response rate of 7.9% which is quite poor. Table 4.I shows the sector sub-populations to be analyzed within the scope of this thesis.

Figure 4.II

VANCOUVER BOARD OF TRADE
1177 West Hastings Street,
Vancouver 1, B.C.

THE UNIVERSITY OF BRITISH COLUMBIA
VANCOUVER 8, CANADA
FACULTY OF
COMMERCE AND BUSINESS ADMINISTRATION

LOCATION SURVEY   CONFIDENTIAL

1. For each of the following factors would you please indicate the level of importance in your decision to locate your business in the Vancouver Region.

1.	unimportant	2.	fairly important
3.	important	4.	absolutely essential

Place 'X' under appropriate column.

FACTORS	1	2	3	4
1. Nearness to markets	___	___	___	___
2. General labour supply	___	___	___	___
3. Skilled labour supply	___	___	___	___
4. Employee wage scales	___	___	___	___
5. Local property and business taxes	___	___	___	___
6. Truck transportation	___	___	___	___
7. Rail transportation	___	___	___	___
8. Water transportation	___	___	___	___
9. Air transportation	___	___	___	___
10. Land prices or lease rates	___	___	___	___
11. Construction costs	___	___	___	___
12. Local government attitude to industry	___	___	___	___
13. Cost of utilities	___	___	___	___
14. Availability of public transportation for employees	___	___	___	___
15. Availability of amenities in region	___	___	___	___
16. Availability of housing for employees	___	___	___	___
17. Availability of large tracts of land	___	___	___	___
18. Absence of traffic congestion	___	___	___	___
19. High quality environment	___	___	___	___
Other (please specify)	___	___	___	___
_____	___	___	___	___
_____	___	___	___	___
_____	___	___	___	___
_____	___	___	___	___

VANCOUVER METROPOLITAN INPUT - OUTPUT STUDY

VANCOUVER BOARD OF TRADE
1177 West Hastings Street,
Vancouver 1, B.C.

THE UNIVERSITY OF BRITISH COLUMBIA
VANCOUVER 8, CANADA
FACULTY OF
COMMERCE AND BUSINESS ADMINISTRATION

LOCATION SURVEY   CONFIDENTIAL

2. If you were to move from the Vancouver Region, would you please indicate the level
of importance of the following factors in your decision to relocate elsewhere.

| 1. | unimportant | 2. | fairly important |
| 3. | important | 4. | absolutely essential |

Place 'X' under appropriate column.

FACTORS	1	2	3	4
1. Nearness to markets	—	—	—	—
2. General labour supply	—	—	—	—
3. Skilled labour supply	—	—	—	—
4. Employee wage scales	—	—	—	—
5. Local property and business taxes	—	—	—	—
6. Truck Transportation	—	—	—	—
7. Rail Transportation	—	—	—	—
8. Water Transportation	—	—	—	—
9. Air Transportation	—	—	—	—
10. Land prices or lease rates	—	—	—	—
11. Construction Costs	—	—	—	—
12. Local government attitude to industry	—	—	—	—
13. Cost of utilities	—	—	—	—
14. Availability of public transportation for employees	—	—	—	—
15. Availability of housing for employees	—	—	—	—
16. Availability of amenities in region	—	—	—	—
17. Availability of large tracts of land	—	—	—	—
18. Absence of traffic congestion	—	—	—	—
19. High quality environment	—	—	—	—
Other (please specify)	—	—	—	—
_____	—	—	—	—
_____	—	—	—	—
_____	—	—	—	—
_____	—	—	—	—

Table 4.I   Subpopulations Analyzed

	Subpopulation	Inclusive Sectors	Number of Cases
1.	Primary Industries	1.1 - 4.3	14
2.	Manufacturing Industries	5.1 - 13.3	85
3.	Retail Trade Industry	14.1	28
4.	Wholesale, Trade and Storage	15.1	30
5.	Infrastructure Industries	16.1 - 17.3	12
6.	Financial and Administrative Services	18.1 - 27.1	131
7.	All Industry Sectors	1.1 - 27.1	300

Inferences about the relocation and intrametropolitan location of some subpopulations are constrained by the limited number of cases for these subpopulations. A detailed description of the inclusive sectors appears in Appendix I.

The usable response rate is further constrained by missing values. Although a few respondents did not reveal the number of employees or attribute importance to a particular factor, several failed to answer either questions 1 or 2 of the location survey question- naire. 15 failed to answer question 1; 83 failed to answer question 2. Thus complete responses, i.e. answers to both questions 1 and 2, were only received from 202 firms or 67.3 per cent of the total number of firms included in this survey. Given the similar format on both sides of the questionnaire in Figure 4.II and the larger number of null responses to question 2, it appears that several respondents did not realize that there is a question 2.

The following suggestions might have improved the quality, reliability and completeness of the questionnaire returns, given the

poor response rate of the mailed survey.

1.   A simple notice such as, "There are two _different_ questions,
please answer _both_ sides of this survey" printed on both sides of
the questionnaire might have caused more complete responses.

2.   The location survey questionnaire should have been mailed
separately from the input-output questionnaire. Although this entails
greater expense, the low response to the input-output questionnaire
would not impair responsiveness to the location survey questionnaire.

3.   Although a personally administered questionnaire is far more
time consuming than mailed questionnaires, the quality, reliability
and completeness of the questionnaires are more controlled via personal
rather than written contact with prospective respondents. For example,
the researcher could administer the questionnaire only to people re-
sponsible for determining the firm's present location. Personal factors,
although of a qualitative nature, could be identified under the
variable "Other (please specify)". The variability and magnitude of
the personal factors would set a subjective constraint on data inter-
pretation. If the same personal factor occurs on several questionnaires,
this factor would appear in subsequent questionnaire studies. A personal
interview also enables elaboration on which aspects of a particular
factor, i.e. high quality environment, are important, as well as clar-
ification of any misunderstandings about the questionnaire.

        A major disadvantage of both personal and mailed questionnaires
is that there is always some uncertainty as to whether scores are
true or merely represent some degree of perceptional bias.

        There are some limitations to the present questionnaire which
could be rectified to obtain better data.

1.   This study is severely limited because it is unknown when

the decision was made by firms to locate in the G.V.R.D. Tables 3.I,

3.V, and 3.VI however, reveal that the G.V.R.D. is a growing region.

This is important because, as Goldberg suggests, intrametropolitan

location is best studied in,

> "...an area which has been the scene of recent location
> decisions. Otherwise, what we will observe is the
> skeleton of decisions made in years past for reasons
> generally irrelevant today."[11]

There should be a question which determines when the firm established

operations in the G.V.R.D. The answer would provide a reliability

index to question 1. Indeed, it is doubtful whether a 30 year old

firm could honestly answer question 1 and even if it could, the reasons

for initially locating are not necessarily the reasons for maintaining

the same location. There should also be a sequel to question 1 which

reads: "For each of the following factors would you please indicate

the level of importance in your decision to presently remain located

in the Vancouver Region." Significant differences between this and

question 1 would reveal the degree of irrelevancy of previous location

decisions to those of today. It could also be determined after how

much time, i.e. 7 years, irrelevency between former and present decisions

becomes significant. Thus, only recently, i.e. 7 years or less, say,

located firms would be analyzed.

2.   A question should be included which asks whether respondents

actually intend to move. The hypothesis that older firms are more

dissatisfied with their present location than newer firms could then

be tested. Conditional to firms answering "yes" to this question,

they should be asked the municipality, province or country to which

they plan to move. In this regard, question 2 should be re-phrased to

read, "If you were to move _within_ the Vancouver Region, would you please indicate the level of importance of the following factors in your decision to relocate." Thus, intrametropolitan movement trends by size classes and industry subpopulation could aid the land use group in their development of models which allocate economic activities across the Region.

3.   Question 1 asks respondents to consider the importance of nineteen location factors in their decision to locate in the Vancouver Region. All of these factors have potential to spatially vary in an intrametropolitan context. Question 1 is interregional in nature because the VMIS considers the regional economy as a point in space. However, intrametropolitan analysis of the location survey questionnaire is possible because the precise location for most firms is known. Thus, spatial analysis of the variation of these factors for a given subpopulation within the Region is feasible. This limited approach to empirically assess intrametropolitan location can be improved if a supplement to question 1 states, "For each of the following factors would you please indicate the level of importance in your decision to locate your business in the particular municipality in the Vancouver Region." Thus, the importance of the location factors at the regional and intrametropolitan levels could be fully established and compared.

4.   More precise definition of the factors is required in future studies. For example, is the factor "Truck transportation" used in the context of availability of, cost of, or both? Is the "Availability of large tracts of land" required for a large plant, onsite expansion, or both?

From the above, it becomes apparent that the quality, reliability and completeness of the location questionnaire survey is quite limited

for an intrametropolitan location study of the G.V.R.D. Only through
the continual "de-bugging" of this and subsequent questionnaire
studies can the questionnaire's utility as an empirical data base
be improved.

D. An Overview of the Location Survey Questionnaire Factors

The following is an overview of the location survey question-
naire factors. Several of these factors appear suited to a regional
rather than intrametropolitan location study because they usually
display the most variation at the regional level. Goldberg states,

> "It should be clear that regions from a locational
> viewpoint tend to be quite homogeneous from within.
> Therefore,...the variables which can be reasonably
> utilized are few in number and difficult to measure."[12]

As suggested above, future surveys could measure the difference which
these variables have at the regional and intrametropolitan levels.
Thus, it is unknown whether or not a particular regional factor in-
fluences only the regional portion of the location decision or the
regional and, to some degree, the intrametropolitan location decisions
of a given firm in the G.V.R.D. The solution to this query might provide
an empirical synthesis between regional and intrametropolitan location.
This study provides limited intrametropolitan spatial analysis of the
variation of these factors for given subpopulations. That spatial
variation of regional factors exists in this study at the intrametro-
politan level suggests further research into the empirical synthesis of
regional and intrametropolitan location is required.

1. Nearness to markets

Nearness to markets can be considered in a regional and intra-metropolitan context. These two concepts, undifferentiated in the present questionnaire, vary in importance for different firms. Metropolitan Vancouver has relatively good access to worldwide markets due to its break-of-bulk location. There are, however, varying degrees of market accessibility at the intrametropolitan level. As previously mentioned, there is less spatial interaction between Vancouver's central and peripheral rings than within them because of transportation linkages. Intrametropolitan nearness to markets depends upon the availability and efficiency of truck, rail, water, and air (i.e. seaplane) transportation. The absence of traffic congestion is mainly related to truck transportation although it has limited relevance to the other three transport modes mentioned above. Figure 4.III demonstrates the spatial friction of distance in terms of road travel time from the C.B.D. Nearness to the C.B.D. market decreases quickly with respect to distance because the travel time to the C.B.D. rapidly increases with respect to distance. Therefore, firms must effect a tradeoff between nearness to central and/or peripheral markets in Metropolitan Vancouver.

2. General labour supply and 3. Skilled labour supply

The supply of both general and skilled labour is influenced by the government's policies on minimum wages, labour laws, immigration and employment; as well as the wages and training of business organizations. With respect to the present study area,

> "Greater Vancouver has...a well-educated productive
> labour force....Included in this labour pool is
> virtually every type of skill required by commerce
> and industry."[13]

Figure 4.III   Greater Vancouver Regional District, 1968:
                Travel Time Zones.
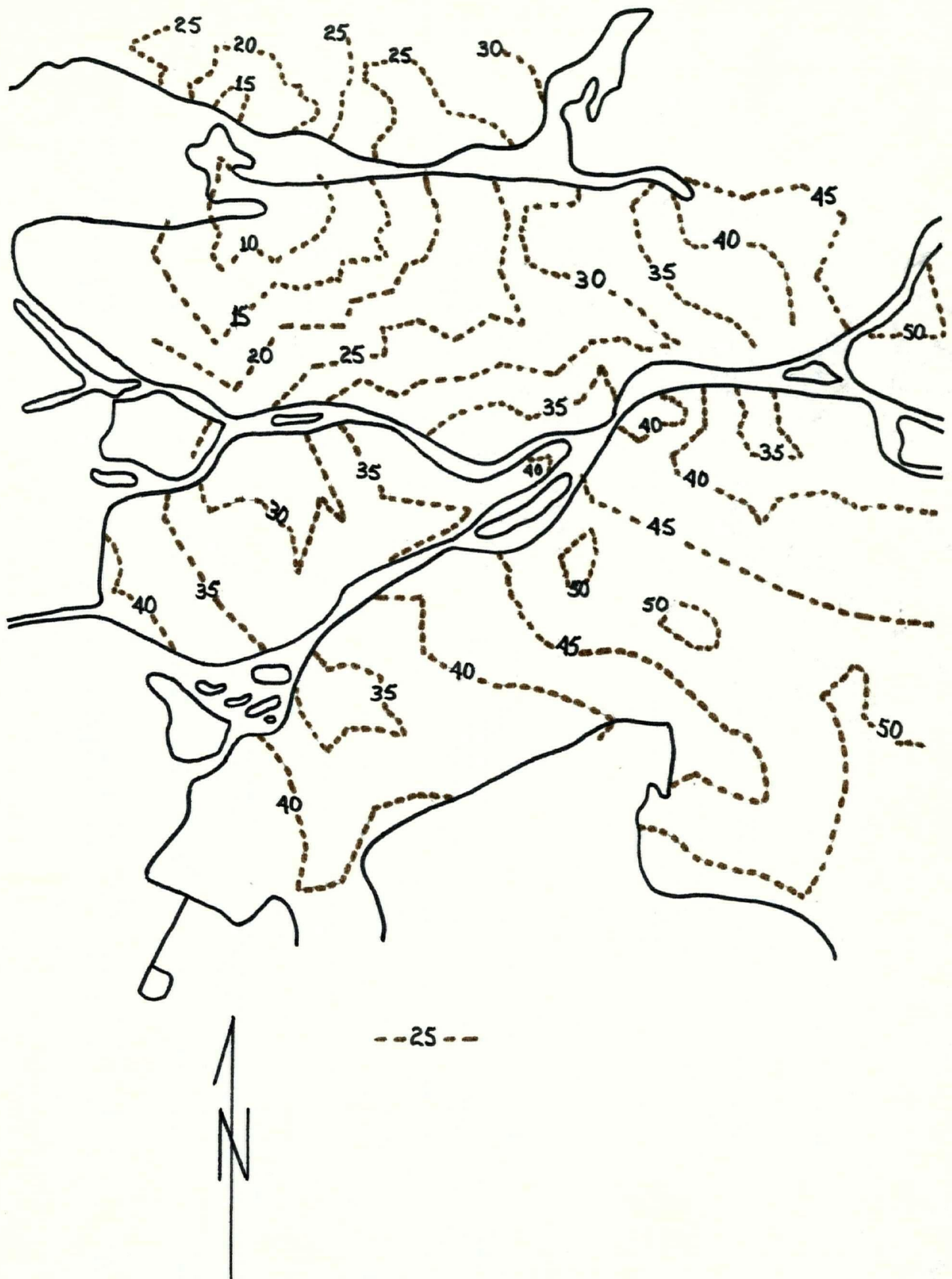
Source: Space for Industry, Greater Vancouver
         Regional District Planning Department,
         December 1970, pp. 9,10.

Since skilled workers generally earn more than unskilled workers, it is reasonable to assume that skilled workers generally live in better quality residences than unskilled workers. In other words, the supply of labour varies spatially within a metropolitan area. It is therefore paramount that firms which require a certain type of labour locate in close proximity to this labour. If this is not possible, higher wages or other benefits are required to attract the labour supply. Consideration of availability of public transportation and housing for employees are also related to the problem of procurement of suitable labour inputs to a firm's production function.

Attention to labour cannot be overstated since increased productivity typically results from employee satisfaction.

4. Employee wage scales

F.O.B. labour costs are essentially homogeneous throughout the intrametropolitan region. Wage homogeneity is reinforced by trade union agreements which typically apply throughout an urban region. Competitive wage rates, which further strengthen wage homogeneity, typically occur in urban regions because knowledge of regional wage rates is easily obtained. As suggested above, firms which are relatively inaccessible to the required labour supply, may have to provide additional benefits, i.e. travelling time, a company car, etc., to compensate for their inaccessibility. It is therefore possible that certain intrametropolitan locations require relatively higher employee wage scales to procure labour inputs at a tradeoff for the availability of other factor inputs, i.e. availability of large tracts of land.

5. Local property and business taxes

Goldberg suggests that business taxes are constant within a region. Although local property taxes vary, they only comprise a small percentage of total business taxes.[14] That local property taxes are unjustly distributed in the G.V.R.D. is established by Tomko who states:

> "...Assessment uniformity does not exist within the municipalities studied, and the degree of uniformity varied with the different municipalities...Uniformity of assessments implies that the assessments of properties within a municipal jurisdiction are a uniform percentage of their market value...Equality of assessment between municipalities and land uses are not traits of the Property Tax System in British Columbia...Equalization of assessments implies that the average assessment-market value ratios of municipalities be equal."[15]

Therefore, there is an unjust distribution of the tax burden in the G.V.R.D. because either uniformity or equality does not exist.[16] Since local property taxes do vary, it is possible that this factor influences intrametropolitan location.

6. Truck transportation

Trucks yield excellent advantages over other modes of transport in an intrametropolitan area because they have relatively lower initial loading costs and offer door to door service. The availability of truck transportation in the G.V.R.D. is related to the major highway network shown in Figure 3.VIII. Intrametropolitan costs of truck transport, assuming equal bulk, depend on time/distance considerations. From Figure 4.III, a firm which depends heavily on truck transportation to ship outputs to the C.B.D. will find a peripheral location a disadvantage with respect to truck transportation. Therefore, the availability and cost of truck transportation can influence the intrametropolitan location of certain firms.

7. Rail transportation

Rail transportation is mainly used to transport goods over long distances due to relatively high initial loading costs and scale economies. Consequently, the volume of intrametropolitan rail freight is a small percentage of total rail freight transport. The availability of rail services shown in Figure 4.IV varies significantly within the G.V.R.D. and accordingly, can influence the intrametropolitan location of certain firms. B. C. Hydro, for example, offers sites along its railroad complete with siding trackage if desired. Note in Figure 4.IV that traffic can be interchanged and through rates are available. The B. C. Hydro Railway connects into the: C.N.R., C.P.R., Burlington R.R., Milwaukee Road and B.C. Railway; the C.P.R. connects into the C.N.R., B.C. Railway and Great Northern Railway.

8. Water transportation

Metropolitan Vancouver has three major port areas shown in Figure 3.I: Burrard Inlet, Roberts Bank and the Fraser River. A fourth area, Sturgeon Bank, is viewed as a reserve area, potentially suitable for port use only when the above areas approach full utilization. Figure 3.VIII reveals that the South Arm of the Fraser River is suited to deep-sea shipping while the North Arm of the Fraser River is suited to shallow draft vessels. The spatial choice of water transport services accordingly influences the intrametropolitan location of certain firms. The high demand for industrial waterfront property suggests that proximity to water transport services is critical for some firms. Main waterfront users are saw, plywood and paper mills, fish canneries, shipyards, petroleum refineries, and non-metallic minerals industries.[17]

Figure 4.IV   Rail Transportation in the G.V.R.D.

B.C.H.B. Railway	
Burlington Railway	
B.C. Hydro Railway	
C.N.R.	
C.P.R.	
B.C.Railway	

0 1 2 3
Miles

Source: Industrial Development Dept., B.C.Hydro
          & Power Authority, Vancouver, B.C.

9. Air transportation

Figure 3.I shows the location of Vancouver International
Airport. Most of Metropolitan Vancouver's air traffic flows through
this airport except for the seaplane base in Coal Harbour which is on
the north side of the C.B.D. Firms increasingly consider their prox-
imity to airports because these facilities offer rapid service at
relatively economical rates. A supplier of parts for equipment used
in British Columbia's mining industry would probably choose an intra-
metropolitan location whose time/distance is relatively close to the
airport. Should a breakdown occur, the required part can be rushed
to meet the earliest flight. Moreover, the trend in air cargo is
changing. Not only can firms which ship low weight to high value take
advantage of air freight but firms which ship bulkier cargo, i.e.
Volkswagen cars, or perishable cargo, i.e. tropical produce, increas-
ingly take advantage of the scale economies rendered by Jumbo Jets.

In order to meet the demands for air transport, Figure 4.V
depicts the Federal Government's 1972 plans to build on the northern
portion of Sea Island: a runway for containerized air cargo and a
water/air cargo container terminal. Cost of the new runway system and
additional services is estimated at $14 million. The major reason for
the expansion is to replace existing air cargo facilities which are
insufficient to handle the volume of cargo anticipated from jumbo jets.
Air cargo tonnage is expected to increase from 40,000 tons/year at
present to 80,000 tons/year in 1977. On this basis, completion date
is set for 1977-78.[18]

Figure 4.V: Vancouver International Airport: Sea Island.

Proposed water/air cargo
container terminal

Proposed Runway for Cargo

Bridge under construction

Passenger Terminal

Proposed Road

Existing Runway

Old Road to be dismantled

N

Existing Cargo Facilities

Seaplane Base

Areas to be Expropriated
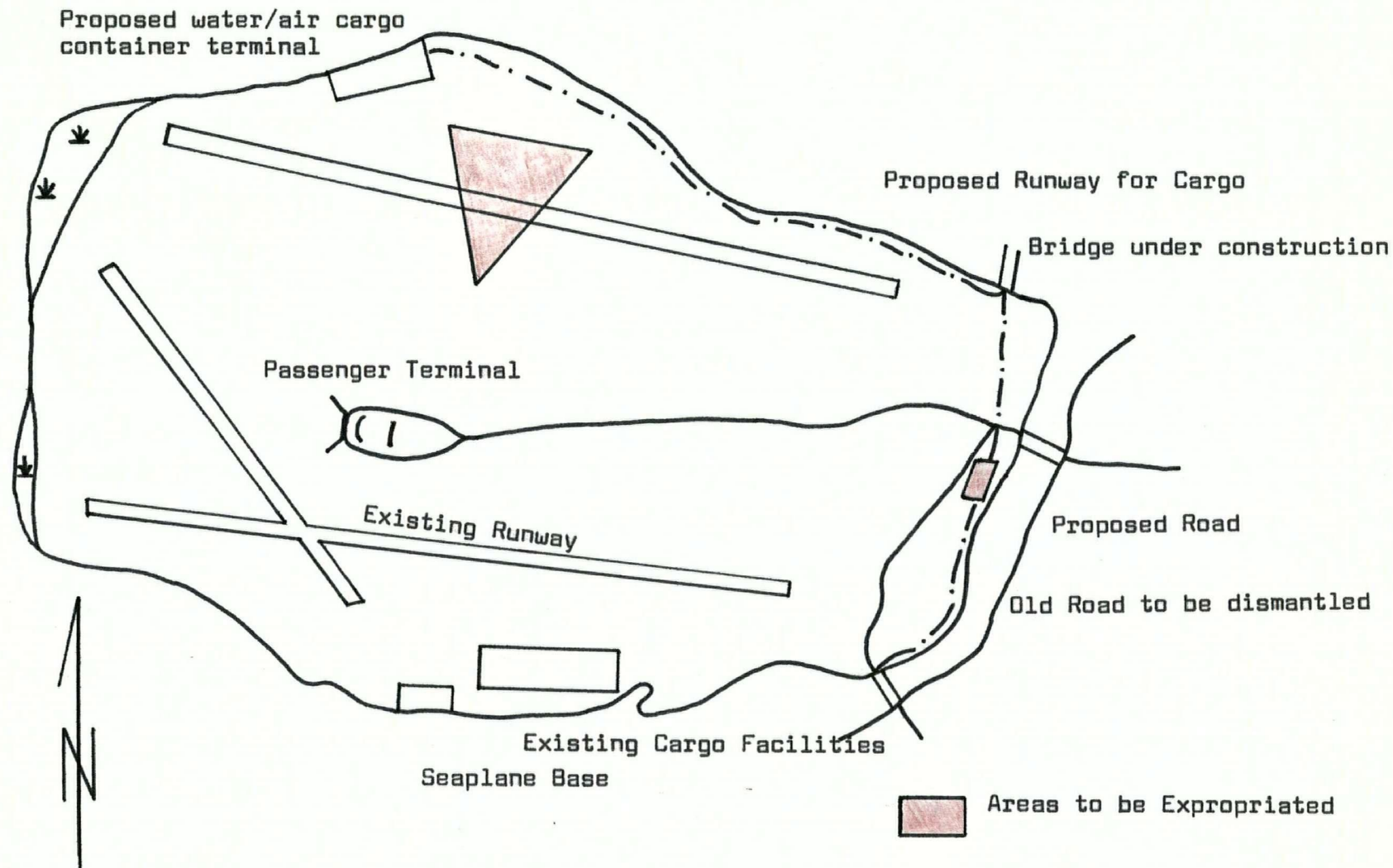
Source: An Interview with D.H.MacLeod, A.A.C.I.:   Department of Public Works.

10. Land prices or lease rates

Land prices and lease rates vary significantly at the intra-metropolitan level. This variation is essentially caused by differential site qualities and relative location which interact through the supply and demand mechanism. Appendix II shows industrial and commercial land values for selected sites in Metropolitan Vancouver, 1972. Industrial land values continue to generally rise due to increased demand.[19] Commercial land values remained relatively stable with value increments, due to increased demand, occurring in the C.B.D. between Thurlow and Seymour Streets.[20]

The following discussion of lease rates refers to rental rates per annum.

Retail lease rates along principal transportation corridors continued to rise with demand in 1972. Supply of C.B.D. retail space only marginally expands in the major office developments. Retail lease rates in the C.B.D. range from $7.00 to $8.00 per square foot rising to over $12.00 per square foot for the prime corner location. Elsewhere in the G.V.R.D., rates range from $3.50 to $5.00 per square foot.[21] Lease rates of industrial and office sites are also included in Appendix II. Since the supply presently exceeds demand for warehouse space, rental levels of industrial buildings remain relatively stable for 1972.[22] Rental demand for older multi-storey warehouse and industrial buildings, which are mostly located in the C.B.D., is declining. Unrefurbished buildings rent from $.80 to $1.00 per square foot for the ground floor and $.40 to $.75 per square foot for the upper floors. Refurbished buildings rent up to $2.50 per square foot for the ground floor.[23] Office rental rates, included in Appendix II, have levelled off due to an excess of supply over demand.[24]

11. Construction costs

The cost to construct a building is comprised of several factors, some of which are unique to a given project. Employee wage scales and amount of labour, materials, legal fees and financing are but a few of the construction cost components. Some of these factors are further influenced by the technological form and scale economies of the project. Aside from employee wage scales, it is reasonable to suggest that the construction cost factor inputs of a given project do not vary significantly for an intrametropolitan area. However, the unique qualities of a particular site can influence construction costs whence intrametropolitan location. The drainage, foundation conditions, topographical features, and whether or not the site is cleared, are factors which can strongly influence the construction cost, indeed the feasibility, of a project. The range of construction costs for different structures is shown in Appendix II.

12. Local government attitude to industry

Local government attitude to industry is principally reflected through zoning. Since municipalities require tax revenue, a specific zoning policy within geographical constraints is adopted in order to strengthen a municipality's economic base. Therefore, zoning varies by municipality and accordingly influences intrametropolitan location in the G.V.R.D.

Favourable attitude to industry is, however, conferred by certain organizations. Operating under provincial legislation, B.C. Hydro encourages industrial development throughout the Region. Here, flexible financial terms and project development are maintained. Whenever a project in Metropolitan Vancouver lies beyond the scope of

individual municipalities or can be undertaken by a liason organization, the G.V.R.D. (organization) fulfills this need by providing services, regulating and controlling activities, undertaking works, and, in general, exercising functions which it adopts. Furthermore, the Industrial Development Commission, created by regional municipalities and industry, offers a wide range of business services, i.e. site availability, land prices, statistics and legal advice, without fee and in strictest confidence.

13. Cost of utilities

The utility tariff rate for gas and electricity is equal throughout the G.V.R.D. Electricity, for example, is costed either by a block or demand energy rate for respectively smaller or larger loads. With a block rate, price decreases with greater usage. A lower price per K.W.H. is charged for more efficient usage under a demand energy rate.[25] Usage and efficiency of usage vary spatially because, as Goldberg demonstrates, a firm's production function and scale itself vary spatially.[26] Therefore, the cost of utilities to a given firm under a constant rate structure varies throughout Metropolitan Vancouver.

Associated with the cost of utilities is their availability. If demand for electricity exceeds 5,000 K.W.H., the firm requires a transmission line rather than a distribution line. Lafarge Cement Ltd., Hooker Chemicals Ltd. and oil refineries are examples of such users. Since transmission lines vary spatially in their availability, intrametropolitan location is influenced accordingly. Availability is usually reinforced by zoning such that if a firm requires a C.B.D. location and more than 5,000 K.W.H., zoning precludes the firm from a C.B.D. location.[27]

14. Availability of public transportation for employees

The availability of public transportation for employees varies spatially in the G.V.R.D. in terms of service frequency and number of routes. Employees are most likely to use public transport on weekdays between 7.00 a.m. and 10.00 a.m., and 4.00 p.m. to 7.00 p.m. Bus timetables reveal significant spatial variation of service frequency at these times. For example, between 7.00 a.m. and 8.00 a.m. on weekdays, 12 buses stop at 41st and Granville heading north while in the same period only 2 buses leave the Sexsmith loop for Richmond. Similar contrasts between central and peripheral locations exist on other routes.[28] The reason for the variation in service frequency is essentially based on aggregate demand which is related to population density. Consequently, the employee who lives in a peripheral location receives less frequent bus service than if he lived in a central location. There are also fewer bus routes in peripheral locations. This could cause some inconvenience to walk to a bus route. Accordingly, the spatial variability of public transportation for employees could influence the intrametropolitan location of certain firms.

15. Availability of amenities in the region

Amenities such as adequate highways, heating, schools, sewage, light, water, and fire and police protection are generally offered throughout Metropolitan Vancouver. In some peripheral locations however, the absence of some of these important amenities accordingly influences intrametropolitan location.

16. Availability of housing for employees

Availability of housing for employees can be important to firms which desire employee loyalty. The availability of housing at a price

which employees can afford varies spatially as well as by firm. Firms which desire to locate or relocate within the Region might discover that availability of housing for employees significantly determines the intrametropolitan locational choice.

17. Availability of large tracts of land

The availability of large tracts of land is required by some firms to accommodate a land extensive plant and/or to enable future on-site expansion. Since large tracts of land are generally less costly and more abundant in peripheral locations, intrametropolitan location is influenced by this factor.

18. Absence of traffic congestion

Traffic congestion varies in both time and space. In Metropolitan Vancouver, congestion generally increases on main arteries which lead toward bridges. This occurs in the direction toward the C.B.D. from 7.00 a.m. to 9.00 a.m. and away from the C.B.D. from 4.00 p.m. to 7.00 p.m., Monday through Friday. Congestion also occurs at a more micro level in the context of accessibility whereby absence of traffic congestion in relation to a particular site is important. Large retail shopping centres are usually considerate of this factor in planning their location.

19. High quality environment

The environmental quality of a given site depends somewhat upon the individual's subjective perception of what constitutes high quality. Nevertheless, the absence of pollution and the presence of architectural and natural scenery are environmental quality considerations. These considerations vary throughout the intrametropolitan area and are likely to be important to office and retail location decisions.

E. <u>Summary</u>

This chapter establishes that the present location question-
naire survey is of greater use to the land use rather than economics
group of the IIPS study. However, significant changes in the
questionnaire are required to fully establish the importance of the
location factors at the intrametropolitan level. Limited intra-
metropolitan analysis of the location survey questionnaire is possible
because the precise location for most firms is known. The factors
which comprise the survey appear suited to a regional rather than
intrametropolitan location study because they usually display the
most variation at the regional level. It is, however, argued that
these factors can significantly vary at the intrametropolitan level.
That spatial variation of regional factors exists in this study at
the intrametropolitan level suggests that further research into the
empirical synthesis of regional and intrametropolitan location is
required.

F. References

[1] Perloff, H.S., _Education for Planning_, (Baltimore: John Hopkins Press, 1957), pp. 11-12.

[2] This specific simulation model is a replica, expressed mathematically, of the way the G.V.R.D. grows and functions. Manipulation of the model enables assessment of the present or future consequences of policy decisions in order to avoid undesirable policies.

[3] Goldberg, M.A., "The Inter-Institutional Policy Simulator: IIPS" in _Real Estate Trends in Metropolitan Vancouver 1972-1973_, (Vancouver, B.C.: Statistical and Survey Committee, 1973), p. 5.

[4] _Ibid._, p. 7.

[5] _Ibid._, pp. 5-7.

[6] Identity of those firms or activities which comprise the economic base and an approximate numerical value of the economic base multiplier are paramount. Canadian cities typically have an economic base multiplier of approximately two. This means that one export job supports two local jobs; control of firms in a city's economic base is desirable. The economic base multiplier is derived from the ratio T/E where T = total urban employment and E = total export urban employment.[7]
Three well-known methods to measure the economic base are: the "whole industry method", the "value added method", and the "minimum requirements method." A general weakness with these three methods is that categorization of employment as either export or local is not easily attained; that over time, local activities change into export activities; and that since the multiplier is affected by city size, the nation provides the only valid measurement unit.[8] Also, agglomeration economies caused by an export activity can attract new jobs, aside from those local jobs supported by the export activity, to an area's economic base.[9]

[7] Smith, W. F., "Principles of Urban Development", (Vancouver, B.C.: University of British Columbia, 1972), p. 103.

[8] Roterus, V. and Calef, W., "Notes on the Basic-Nonbasic Employment Ratio", Economic Geography, 31, (1955), pp. 17-20.

[9] Smith, W.F., Op. cit., p. 134.

[10] _Ibid._, p. 133.

[11]Goldberg, M.A., Intrametropolitan Industrial Location: Size and the Theory of Production, (Berkeley: University of California, 1969), pp. 186-187.

[12]Ibid., p. 9.

[13]The editor(s), "Greater Vancouver, British Columbia, Canada" (Vancouver and Lower Mainland Industrial Development Commission, Vancouver, B.C., 1971) p. 1.

[14]Goldberg, M.A., Loc. cit., p. 6.

[15]Tomko, W. L.,"An Analysis of the Real Property Assessments and Taxes in British Columbia,"(Vancouver, B.C.: unpublished M.Sc. thesis, 1972), pp. 44, 117, 118.

[16]Ibid., p. 118.

[17]Space for Industry, G.V.R.D. Planning Department, 1971, p. 28.

[18]This information was obtained in an interview in February, 1972 with MacLeod, D.H., A.A.C.I., Vancouver Regional Manager of Property Services for the Department of Public Works.

[19]"Office Space Survey, 1972." This survey was conducted by Western Realesearch Corporation Ltd. for the Real Estate Board of Greater Vancouver in Real Estate Trends in Metropolitan Vancouver 1972-1973 (Statistical and Survey Committee, Vancouver, 1972) p. C-20.

[20]Ibid., p. C-24.

[21]Ibid., p. C-25.

[22]Ibid., p. C-21.

[23]Ibid., p. C-22.

[24]Ibid., p. C-7.

[25]This information was obtained in a telephone interview on March 6th, 1973 with Mr. George Barnett of B. C. Hydro.

[26]Goldberg, M.A., "Intrametropolitan Industrial Location and the Theory of Production" (unpublished article, U.B.C., 1971) pp.1-20.

[27]This information was obtained in a telephone interview on March 6th, 1973, with Mr. George Barnett of B.C. Hydro.

[28]This information was obtained from current bus timetables of the British Columbia Hydro and Power Authority.

CHAPTER V

ANALYSIS OF THE QUESTIONNAIRE DATA

A. <u>Introduction</u>

This chapter explains the general method and summarizes the significant analytical results of the location survey questionnaire. A brief mathematical Appendix IV is included for the reader's convenience; Appendix III contains data which is pertinent to Chapter V. The importance of specific questionnaire variables in the location/relocation decision is established. The size/location factor regression models provide a limited empirical data base for the land use group in their development of models which allocate economic activities across the Region.

The "Statistical Package for the Social Sciences" (SPSS)[1] is used to perform the analysis because:

> "1. Several different types of desired data analysis
>   can be simply and conveniently performed by a person
>   with no programming experience; and
>
> 2. SPSS is extremely flexible with respect to data
>   formats."[2]

There are 43 variables considered in the statistical analysis; Table 5.I defines each variable:

Table 5.I   Variables Considered in the Statistical Analysis

ID. Number: V001

SIC Number: V002

Sector Groupings: V003

1.1	-	1.3:	1	15.1 -	: 15
2.1	-	2.2:	2	16.1 - 16.7:	16
3.1	-	:	3	17.1 - 17.3:	17
4.1	-	4.3:	4	18.1 - 18.3:	18
5.1	-	5.6:	5	19.1	: 19
6.1	-	6.4:	6	20.1	: 20
7.1	-	7.2:	7	21.1	: 21
8.1	-	8.2:	8	22.1	: 22
9.1		:	9	23.1 - 23.2:	23
10.1	-	10.2:	10	24.1	: 24
11.1	-	11.2:	11	25.1	: 25
12.1		:	12	26.1	: 26
13.1	-	13.3:	13	27.1	: 27
14.1	-		14		

Number of Employees: V004

Location Code: V005

1. C.B.D.
2. Vancouver: N.W.
3. Vancouver: N.E.
4. Vancouver: S.W.
5. Vancouver: S.E.
6. Richmond
7. Delta
8. Surrey
9. Coquitlam
10. New Westminster
11. Burnaby N. (North of the Lougheed Highway)
12. Burnaby S. (South of the Lougheed Highway)
13. Port Moody
14. North Vancouver
15. West Vancouver
16. White Rock
17. U.B.C. endowment lands

Table 5.1   Variables Considered in the Statistical Analysis - continued

Location Survey Variables: V006 to V043 inclusive

Question 1:   For each of the following factors would you please in-
dicate the level of importance in your decision to
locate your business in the Vancouver Region.

Range of responses per variable apart from the null response:

1. unimportant   2. fairly important

3. important   4. absolutely essential

V006:   Nearness to markets

V007:   General labour supply

V008:   Skilled labour supply

V009:   Employee wage scales

V010:   Local property and business taxes

V011:   Truck transportation

V012:   Rail transportation

V013:   Water transportation

V014:   Air transportation

V015:   Land prices or lease rates

V016:   Construction costs

V017:   Local government attitude to industry

V018:   Cost of utilities

V019:   Availability of public transportation for employees

V020:   Availability of amenities in the region

V021:   Availability of housing for employees

V022:   Availability of large tracts of land

V023:   Absence of traffic congestion

V024:   High quality environment

Question 2:   If you were to move from the Vancouver Region, would you
please indicate the level of importance of the following
factors in your decision to relocate elsewhere.

Range of responses per variable apart from the null response:

1. unimportant   2. fairly important

3. important   4. absolutely essential

Table 5.1 Variables Considered in the Statistical Analysis - continued

---

VO25:   Nearness to markets

VO26:   General labour supply

VO27:   Skilled labour supply

VO28:   Employee wage scales

VO29:   Local property and business taxes

VO30:   Truck transportation

VO31:   Rail transportation

VO32:   Water transportation

VO33:   Air transportation

VO34:   Land prices or lease rates

VO35:   Construction costs

VO36:   Local government attitude to industry

VO37:   Cost of utilities

VO38:   Availability of public transportation for employees

VO39:   Availability of housing for employees

VO40:   Availability of amenities in region

VO41:   Availability of large tracts of land

VO42:   Absence of traffic congestion

VO43:   High quality environment

Figure 5.I.   The Location Code, VOO5.
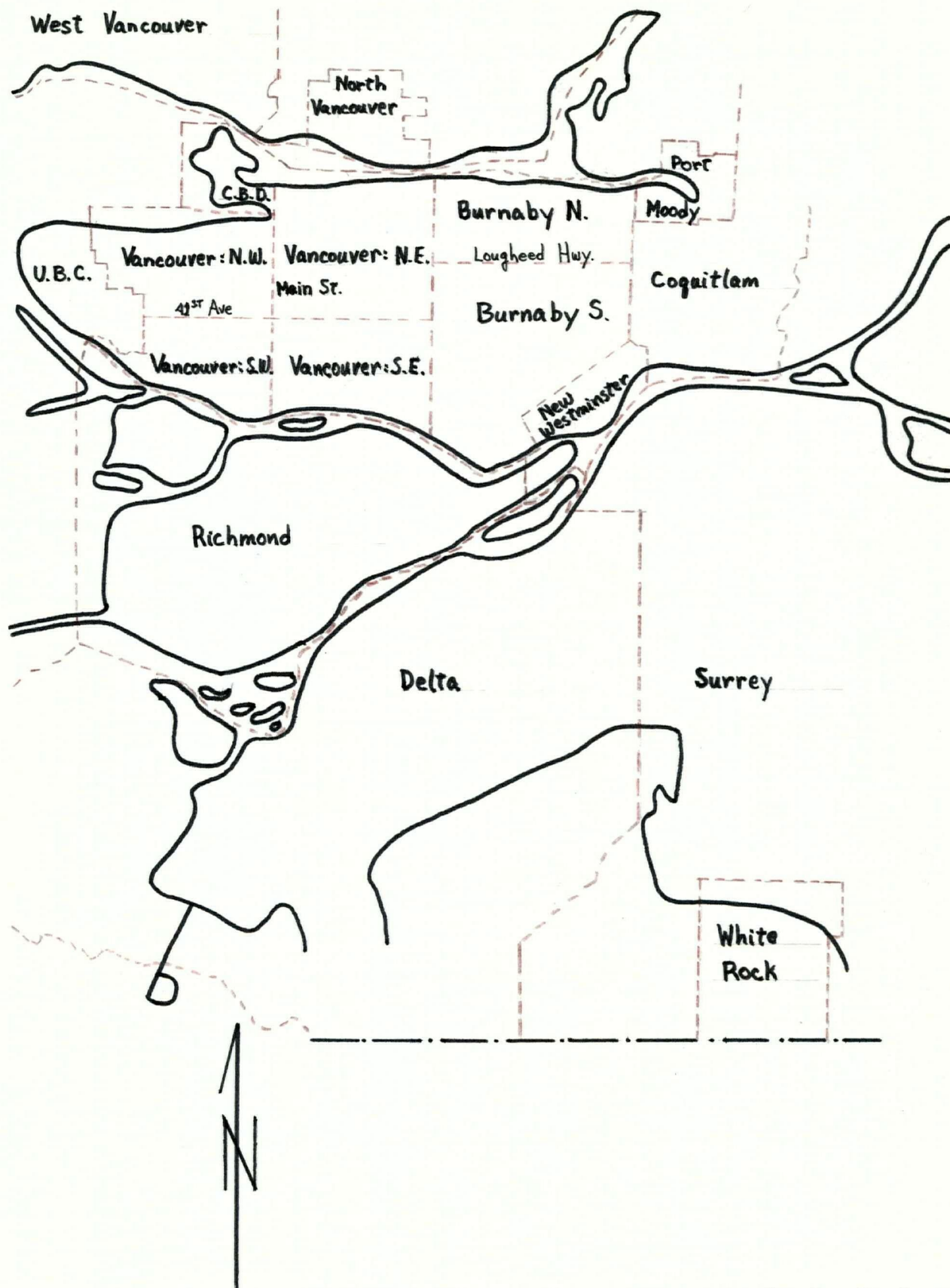
No relevant purpose is served in this report to statistically analyze V001, identification number, or V002, SIC number, because a statistic such as the variance is meaningless for nominal variables. The meagre response also precludes analysis via SIC number. V001 and V002 are, however, treated as variables for programming convenience, while their characteristics are inherently considered via subpopulations of V005, location, and V003, sector, respectively. The location survey variable "Other (please specify)" is ignored in this study due to extremely limited and idiosyncratic response. Figure 4.I is a map which shows each area of V005, the location code.

B. Significance Analysis of Questionnaire Variables

Frequency data derived from the MARGINALS subprogram is used to analyze the questionnaire variables, V006 to V043 inclusive, in terms of their importance. This particular analysis is essentially inter-regional since no spatial variation at the intrametropolitan level is presently considered. The results of this analysis are visually summarized for each subpopulation in Figures I to VIII inclusive in Appendix III. Rather than discuss the importance level of each variable, Tables I to VII in Appendix III isolate variables considered important in the location and relocation decision by subpopulation. Questionnaire variables are grouped arbitrarily in the category labelled "important" if more than 60% of the responses to a given variable are fairly important (factor 2), important (factor 3), or absolutely essential (factor 4). Approximately one-half of the questionnaire variables are important in the location and relocation

decisions for manufacturing, retail, wholesale trade and storage, and all sectors.

From the above, it is apparent that a comparison exists between location and relocation criteria for each subpopulation because each of the variables from question 1 has a counterpart in question 2. The following list summarizes each variable and its counterpart.

Table 5.II. Counterpart Questionnaire Variables

Variable from question #1	Counterpart variable from question #2
V006	V025
V007	V026
V008	V027
V009	V028
V010	V029
V011	V030
V012	V031
V013	V032
V014	V033
V015	V034
V016	V035
V017	V036
V018	V037
V019	V038
V020	V039
V021	V040
V022	V041
V023	V042
V024	V043

Tables I to VII in Appendix III further contain all counterpart pairs which are both important as well as similar in response pattern for questions 1 and 2. The NONPARCORR subprogram is used to generate Spearman rank correlation coefficients as an index of response pattern similarity for counterpart pairs by subpopulation. Nie, Bent and Hull suggest that the Spearman coefficients are applicable to data which is at least ordinal in scale.[3] A two-tailed test of significance is performed because no explicit hypothesis concerning the expected direction of the coefficient is made.[4] Table VIII in Appendix III summarizes statistically significant, i.e. less than or equal to the .05 level, Spearman correlations of counterpart variables by subpopulation. From Table VIII, it is evident that only the primary and infrastructure sectors display a relatively dissimilar response pattern between questions 1 and 2. This response pattern is visually corroborated in Figure VIII in Appendix III. Note that the primary and infrastructure sectors are severely constrained by a respective data paucity of 11 and 12 cases.

C. Intrametropolitan Location of Industry Subpopulations

This intrametropolitan analysis of industry subpopulation location is based on frequency data. SPSS contains four subprograms which yield one-way frequency distributions and related statistics. These four procedures are: CONDESCRIPTIVE, CODEBOOK, FASTMARG and MARGINALS; MARGINALS is used in this study. Each run of MARGINALS produced absolute, relative and cumulative frequency tables. Missing values caused by no response to a questionnaire variable or incom-

plete information provided by a given firm are excluded from the
tables. In fact, missing values are excluded wherever feasible
throughout this study because their inclusion causes a degree of
inaccuracy which increases with the number of missing values
relative to the number of cases.

Tables IX to XV in Appendix III present the absolute and
relative frequencies at each location for a given subpopulation.
Table XV reveals that the location distribution of all firms studied
is heaviest in the central areas: C.B.D., Vancouver N.W. and N.E.
(please refer to Figures 5.I). The remaining industry subpopulations
also reveal a central location distribution but with slight vari-
ations. Table IX shows that the location distribution of primary
sector firms is heaviest in the C.B.D. and moderate in Vancouver N.W.
and Richmond. The location distribution of manufacturing firms in
Table X is somewhat even with heavier concentrations in the C.B.D.,
Vancouver N.E. and N.W. Table XI shows the location distribution of
wholesale trade and storage firms is central with the larger concen-
trations in the C.B.D., Vancouver N.W. and N.E. The location dis-
tribution of retail firms in Table XII is central with larger concen-
trations in the C.B.D. and Vancouver N.W. Table XIII shows that the
location distribution of infrastructure firms is centrally concentrated
in the C.B.D. Financial and administrative service are shown in
Table XIV to be centrally located in the C.B.D., Vancouver N.W. and
N.E. It is noted that the overall trend of centrally located firms
is, in all cases, wholly consistent with Metropolitan Vancouver's
"core-ring" spatial form and the intrametropolitan location of bus-
iness subpopulations developed in Chapter III. It is argued that

the central distribution trends are not caused by the propensity

of head offices to reply because multiple establishment firms were

instructed to report establishments separately.

D. Size-Location Analysis of Industry Subpopulations

Given the frequency distributions of where the various in-

dustry groups locate, analysis of where different sizes of an industry

class locate provides further empirical evidence towards a location

theory which is at least applicable to the Region. BREAKDOWN is used

in this study to analyze the dependent variable V004, number of em-

ployees, with the independent variable V005, location. Goldberg

suggests that the number of employees is a good surrogate of a firm's

size.[5] Table 5.III shows the mean breakdown of V004, number of em-

ployees, by V005, location for all sectors grouped together. Ignoring

locations with only a few cases, Table 5.III reveals that firms which

locate in Richmond, New Westminister, Burnaby S. and North Vancouver

are larger on the average than those located in the C.B.D., Vancouver

N.W., Vancouver N.E., Vancouver S.W. and Vancouver S.E. Although

Table 5.III provides some evidence that larger firms locate centrally

while smaller firms locate peripherally for firms in aggregate, it

is unknown whether these firms are from the same industry subpopu-

lation. Table 5.IV shows the mean breakdown of V004, number of em-

ployees, by location group for each subpopulation. Here, V005,

location, is grouped as either central or peripheral because the

total number of cases for each subpopulation is too small to calcul-

ate meaningful statistics for 17 location categories. It is evident

from Table 5.IV that the mean level of employment differs sub-

Table 5.III   Mean BREAKDOWN of V004, number of employees, by
V005, location.

		Mean	# of cases
1.	C.B.D.	115.342	111
2.	Vancouver: N.W.	53.520	50
3.	Vancouver: N.E.	119.143	28
4.	Vancouver: S.W.	35.286	7
5.	Vancouver: S.E.	111.000	6
6.	Richmond	159.500	14
8.	Surrey	48.143	7
9.	Coquitlam	82.500	2
10.	New Westminster	139.250	8
11.	Burnaby N.	20.5	2
12.	Burnaby S.	195.765	17
13.	Port Moody	2.000	1
14.	North Vancouver	217.182	11
15.	West Vancouver	6.500	4
17.	U.B.C. endowment lands	37.667	3
	Entire Population	108.768	271

stantially between the central and peripheral locations of each sub-
population except the manufacturing sectors. This mean level of
employment differential suggests that larger firms locate centrally
for primary, manufacturing, retail and wholesale sectors while
smaller firms locate centrally for the infrastructure and adminis-
trative sectors. This generalization is qualified by the fact that
for primary, retail, wholesale, infrastructure and administrative
sectors; only 5, 2, 2, 4, and 9 responses were respectively received
from peripheral locations. Moreover, the fact that smaller manu-
facturing plants on average were peripherally located could easily

Table 5.IV   Mean BREAKDOWN of V004, number of employees, by
              location group for each subpopulation

		Central Location Mean		Peripheral Location Mean		Total Population Mean	
1.	Primary Sectors	205.444	(9)	98.600	(5)	167.286	(14)
2.	Manufacturing Sectors	119.404	(57)	84.250	(28)	107.824	(85)
3.	Retail Trade	327.500	(16)	12.500	(2)	292.500	(18)
4.	Wholesale Trade and Storage	105.607	(28)	5.0	(2)	98.9	(30)
5.	Infrastructure	88.857	(7)	463.750	(4)	225.182	(11)
6.	Financial and Administrative Services	54.067	(104)	181.889	(9)	64.248	(113)

Note: Numbers in brackets, i.e. (.), refer to the number of cases
       used in the calculation of a given statistic.

       Central locations are comprised of the C.B.D., Vancouver N.W.,
       N.E., S.W., S.E., Burnaby North, and Burnaby South.

       Peripheral locations are comprised of Richmond, Surrey,
       Coquitlam, New Westminster, Port Moody, North and West Van-
       couver, and the U.B.C. endowment lands.

occur by chance since Steed argues, "Greater Vancouver, however, even
in 1965, had a rather large proportion of small...(manufacturing)...
plants operating outside the inner core..."[6] Therefore, it is un-
certain whether the above size-location generalizations are valid
for given subpopulations due to insufficient data. It can only be
stated with slight confidence that in general, larger firms tend to
locate centrally while smaller firms tend to locate peripherally,
given a centralized distribution of firms in the G.V.R.D.

Since the mean statistic is best understood with its standard

deviation, further analysis of these size-location relationships

is required. However, the mean and standard deviation per se are

not further considered because in all of the cases in Tables 5.III

and 5.IV, the standard deviation is approximately equal to twice

the mean. At best, the use of the mean statistic above is a good

indication of central tendency.

The size-location relationships suggested above are further

analyzed via crosstabulation. In SPSS, FASTABS produces the same

output for integer variables as CROSSTABS but significantly cheaper.[7]

FASTABS is therefore used for the crosstabulation analysis rather

than CROSSTABS. Each run of FASTABS is performed under the default

option since it is desirable to exclude missing data; print labels;

and print row, column and total percentage tables. The statistics

requested for each run of the FASTABS subprogram are summarized as

follows:

> "1. Chi-square (Fisher's test for a 2x2 table when less
> than 21 cases; Yates' corrected X^2 for all other
> 2x2 tables).
>
> 2. Kendall's Tau B."[8]

A brief mathematical discussion of these statistics is found in

Appendix IV.

Table 5.V shows the results of the crosstabulation analysis

of sector, number of employees and location for all sectors. The

very small X^2 significance values associated with V003 x V004 and

V003 x V005 suggest that these two crosstabulations are statistically

dependent. Therefore, labour intensity and the number of employees

depend on the sector in question. The X^2 significance value of

.3168 adds very weak support to the above hypothesis that larger firms locate centrally while smaller firms locate peripherally for firms in aggregate. In fact, Kendall's Tau B significantly suggests a very weak degree of association between size and location.

Table 5.VI shows the results of the crosstabulation analysis of the number of employees and location for each sector group. That larger firms locate centrally for primary and retail sectors is very weakly supported by Fisher's exact test but definitely supported by the significance of Kendall's Tau B. The statistics in Table 5.VI do not support the hypothesis that larger manufacturing firms locate centrally. It appears that no definite relationship exists for manufacturing firms with respect to location and size. This result is in contradistinction to the evidence in Table 3.XII which indicates that larger manufacturing firms locate peripherally and vice versa. Although the corrected X^2 test suggests an independent size-location relationship for wholesale sectors, Kendall's Tau B indicates that there is some tendency for larger wholesalers to locate centrally. The hypothesis that smaller firms locate centrally for the infrastructure and administrative sectors is somewhat supported by Table 5.VI.

Table 5.V   Crosstabulation analysis of sector, number of
            employees and location for all sectors

Note: V003 is grouped into 27 categories, V004 into 4 categories
        and V005 into 17 categories. V004 is grouped as follows:

         1 to 15 employees: group 1
        16 to 60 employees: group 2
        61 to 150 employees: group 3
        151 to 9,999 employees: group 4

Sub-population	Cross-tabulation	X^2 Significance	Kendall's TauB/ Significance	# of Cases
All Sectors	V003 x V004	.0003	Not applicable	272
	V003 x V005	.005	Not applicable	297
	V004 x V005	.3168	.05998/.0706	271

Table 5.VI Crosstabulation analysis of number of employees and
            location for each sector group

Note: Statistics of association are not computed for crosstabulations
        which involve V003 because this variable causes 1x1 or 1x2
        tables to be generated. Here, V005 is grouped as central or
        peripheral while V004 is grouped as follows:

         1 to 60 employees: group 1
        61 to 9,999 employees: group 2

Sub-population	Cross-tabulation	Corrected X^2 or Fisher's Exact Test Significance	Kendall's TauB/ Significance	# of Cases
Primary sectors	V004 x V005	.37762	-.2444/.1117	14
Manufacturing	V004 x V005	.9935	-.02606/.3620	85
Retail Trade	V004 x V005	.35948	-.28204/.0511	18
Wholesale trade	V004 x V005	.7958	-.18898/.0712	30
Infrastructure	V004 x V005	.19697	.44854/.0274	11
Finance and Administration	V004 x V005	.1772	.16691/.0044	113

E. Regression Technique

This study utilizes stepwise linear regression analysis to determine the nature of the relationship between the plant size or number of employees, V004, and the questionnaire variables, V006 to V043 inclusive. Since previous analysis reveals the relationship between V004 and location, it is possible to determine which questionnaire variables increase in importance for firms of the same subpopulation in their decision to locate centrally or peripherally within the G.V.R.D. and to relocate outside the G.V.R.D. It is noted that regression can only demonstrate the statistical tenability of an hypothesized cause-effect relationship. Moreover, Harnett cautions against the "regression fallacy."

> "This fallacy occurs when one attempts to relate the values of a variable at one point in time to the comparable values of that same variable at some other point in time. The problem in using regression or correlation in this circumstance arises because of the tendency for unusually high or low values of a random variable to be followed by more average values."[9]

In order to compute the regression equations, the means, standard deviations and a Pearson correlation coefficient matrix based on all of the regression variables, is calculated. Means and standard deviations are computed such that missing data are excluded per variable to thereby obtain meaningful statistics. Calculation of the Pearson correlation coefficients is performed with pairwise deletion of missing data in order to, "...utilize as much of the data as possible in the computation of each coefficient. Pairwise deletion has the disadvantage...under some circumstances...of producing coefficients...based on a different number of cases."[10] Since the # of cases command used in the regression program specifies the

number of cases the correlations are based on, it is possible to perform regressions using a maximum or minimum number of cases. The maximum case is that of the correlation which uses more cases than all other correlations for a given subpopulation and vice versa. Therefore, what is valid for a regression run using the minimum number of cases is also valid using the maximum number of cases because more information is provided. The converse, however, is not necessarily true although no significant differences between maximum and minimum runs occurred in this study.

Pearson correlation coefficients are used in the regression analysis. Nie, Bent and Hull state that:

> "The choice of the correlation procedure to be used is usually based on the type of data being employed. In general, Pearson product-moment correlations are used with interval scales. Rankings and ordinal categories do not usually have these qualities. The Spearman and Kendall rank-order correlation coefficients are generally used with these ordinal variables....However, in actuality there is no firm agreement among practicing researchers on the selection of correlation coefficients -- particularly on the advisability of the use of Pearson correlations with ordinal data."[11]

Aside from the scale considerations which apply to the questionnaire variables, Kendall's Tau is much more expensive to calculate than Pearson's correlation coefficients. To process missing data, all data used in the computation of both Kendall's Tau and Spearman's rank correlation coefficients must be core resident throughout the calculation procedure.[12] Consequently, the maximum size matrix for file storage of these ordinal coefficients is 30 x 30.[13] Since a 39 x 39 correlation matrix is needed, the only way to use orginal correlations is to keypunch a 39 x 39 matrix onto cards for all seven subpopulations. This astronomical task is severely prone to

error. Moreover, trial runs of ordinal coefficients are comparable
to Pearson's correlations.

The main difficulty in performing regressions over the
questionnaire variables is that it is uncertain whether the four
values which each questionnaire variable can assume represent an
interval scale. Siegel defines an interval scale as one which,

> "...has all the characteristics of an ordinal scale,
> and when in addition the _distances_ between any two
> numbers on the scale are of known size....That is, if
> our mapping of several classes of objects is so pre-
> cise that we know just how large are the intervals
> (distances) between all objects on the scale, then we
> have achieved interval measurement. An interval scale
> is characterized by a common and constant unit which
> assigns a real number to all pairs of objects in the
> ordered set. In this sort of measurement, the ratio
> of any two intervals is independent of the unit of
> measurement and of the zero point. In an interval
> scale, the zero point and the unit of measurement are
> arbitrary."[14]

In order to decide the reasonability of whether an interval scale
and regression equations exist for a given subpopulation, the inter-
vals are transformed to observe the stability of the regression
results.[15] Regressions were performed for each subpopulation on
the questionnaire scale: 1. unimportant, 2. fairly important,
3. important, and 4. absolutely essential. This scale is numerically
equivalent to the vector (0, .33, .66, 1). It is subjectively
reasonable to attribute the value "0" and "1" respectively to the
words "unimportant" and "absolutely essential." However, the numer-
ical distinction between "fairly important" and "important" causes
doubt as to whether an interval scale exists. To overcome this
doubt, regressions were also performed for each subpopulation on the
scale numerically equivalent to the vector (0, .5, .66, 1). A value
of .5 is subjectively attributed to the words "fairly important"

because it also seems reasonable to suggest that respondents per-
ceive a larger difference between "unimportant" and "fairly
important" than "fairly important" and "important". Interval vari-
ation in this fashion enables meaningful interpretation of the
regression results. If little difference in the regression equation
occurs using either scale, one can state that there is essentially
no variation in how respondents interpret the questionnaire scale
numbered 1 to 4. In other words, respondents consistently assume
an interval scale. On the other hand, significant regression
equation differences between the two scales indicates the degree of
unreliability due to the variation of interpretation. Therefore, the
amount of regression change caused by a subjective scale transform-
ation provides an index of response reliability whence the degree to
which it is subjectively reasonable to assume that an interval scale
exists.

F. Regression Results

Question 1: All sectors

The regression equation for all sectors without scale trans-
formation has a low R square value of .1862 yet all of the variables
in the equation are significant at the .01 level. This suggests that
other variables not considered in the questionnaire can also account
for the proportion of variance in V004. The regression equation is:

$$V004 = 103.1V022 - 78.63V017 + 40.63V009 + 23.95V007 + 42.25V021$$
$$- 26.81V024 - 21.23V020 + 11.07V006 - 22.76V011 + 31.54V018$$
$$+ 16.06V014 + 21.58V023 - 18.61V010 - 11.35V019 - 18.47V013$$
$$+ 21.52V012 - 5.99V015 + 3.97V008 - 45.95.$$

The regular regression coefficients are significant (i.e. $F \geqslant 4$)
and their signs may be interpreted with confidence for V022, V017
and V009. Therefore, the normalized regression or BETA coefficients
of these variables may also be used:

Variable	BETA
V022: Availability of large tracts of land	.34
V017: Local government attitude to industry	-.34
V009: Employee wage scales	.15

As V022 and V009 increase in importance and V017 decreases in import-
ance in the decision for all sectors to locate in the G.V.R.D., plant
size or the number of employees, V004, increases. Since similar re-
sults exist for all sectors under the scale transformation (0, .33,
.66, 1) to (0, .5, .66,1), it is reasonable to suggest that regression
is feasible with the all sectors subpopulation for question 1.

Question 2: All sectors

The regression equation for all sectors without scale trans-
formation has a low R square value of .2018 yet all of the variables
in the equation are significant at the .01 level. This suggests that
other variables not considered in the questionnaire can also account
for the proportion of variance in V004. The regression equation is:

$$V004 = 86.02V041 + 60.76V026 - 44.04V035 - 49.27V043 + 39.64V033$$
$$+ 41.88V034 - 17.79V029 + 22.14V039 - 14.77V028 - 9.6V025$$
$$+ 26.02V031 - 21.07V030 - 20.28V032 - 8.57V036 + 8.63V037$$
$$- 6.08V038 - 5.02V040 - 17.11.$$

The regular regression coefficients are significant (i.e. $F \geqslant 4$) and
their signs may be interpreted with confidence for V041, V026, V043,

VO33, and VO35. VO35 is excluded from the analysis however, because
it is insignificant for all sectors under the scale transformation.
The normalized regression or BETA coefficients of these variables
are:

Variable		BETA
VO41:	Availability of large tracts of land	.32
VO26:	General labour supply	.24
VO43:	High quality environment	-.21
VO33:	Air transportation	.15

As VO41, VO26, and VO33 increase in importance and VO43 decreases in
importance in the decision for all sectors to relocate outside the
Region, plant size or the number of employees, VO04, increases.
Since similar results (except for VO35) exist for all sectors under
the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1), it is
reasonable to suggest that regression is feasible with the all sectors
subpopulation for question 2.

Question 1: Primary Sectors

The regression equation for primary sectors without scale
transformation has a maximum R square value of 1.0. All variables in
the equation are significant at the .01 level except VO17, VO19, VO20
and VO15 which are significant at the .1 level. The regression
equation is:

VO04 = -317.68VO17 + 371.29VO19 - 75.65VO20 + 386.69VO15 - 469.11VO10

  + 127.92VO09 + 76.56VO11 + 47.54VO22 - 4.16VO13 + 151.09

The regular regression coefficients are significant (i.e. $F > 4$) and
their signs may be interpreted with confidence for all variables in

the above regression equation. The BETA coefficients are:

Variable	BETA
VO17: Local government attitude to industry	-1.28
VO19: Availability of public transportation for employees	.79
VO20: Availability of amenities in the region	-.24
VO15: Land prices or lease rates	.91
VO10: Local property and business taxes	-1.19
VO09: Employee wage scales	.41
VO11: Truck transportation	.19
VO22: Availability of large tracts of land	.15
VO13: Water transportation	-.02

As VO19, VO15, VO09, VO11, and VO22 increase in importance and VO17, VO20, VO10 and VO13 decrease in importance in the decision for primary sectors to locate in the G.V.R.D., plant size or the number of employees, VO04, increases. The results are somewhat similar for primary sectors under the scale transformation (0, .33, .66, 1) to (0, .5,.66, 1) except that VO11 and VO22 are excluded from the regression equation and VO09 and VO20 have BETA coefficients of different sign and magnitude. Therefore, the stability of transformation is not perfect for question 1, yet the high R square value in both cases indicates that some of the results are salvagable. As VO19, VO15, VO11 and VO22 increase in importance and VO17, VO10 and VO13 decrease in importance in the decision for primary sectors to locate in the G.V.R.D., plant size or the number of employees, VO04, increases.

Question 2:   Primary Sectors

The regression equation for primary sectors without scale
transformation has a high R square value of .99997. All variables
in the equation are significant at the .01 level except V036 which is
significant at the .05 level. The regression equation is:

$$V004 = -751.71V036 - 579.19V033 + 130.83V028 - 117.16V039$$
$$+ 44.21V040 + 4.44V026 + 2477.35$$

The regular regression coefficients are significant (i.e $F \geqslant 4$) and
their signs may be interpreted with confidence for all variables
in the above regression equation. Only the BETA coefficients of the
following variables from the above equation are similar in sign and
magnitude under the scale transformation (0, .33, .66, 1) to
(0, .5, .66, 1):

Variable	BETA
V036: Local government attitude to industry	2.25
V026: General labour supply	.01
V022: Air transportation	- 1.28

As V026 increases in importance and V036 and V033 decrease in import-
ance in the decision for primary sectors to relocate outside the
G.V.R.D., plant size or the number of employees, V004, increases. It
is noted that V028, V039 and V040 in the above equation do not appear
in the regression equation under scale transformation. Therefore,
the above results derived from the BETA coefficients are accepted,
given that regression is only partially feasible for primary sector's
question 2.

Question 1: Manufacturing Sectors

The regression equation for manufacturing sectors without scale transformation has a low R square value of .2711. Most variables in the equation are significant at the .05 level except V009, V014 and V008 at the .01 level and V006 and V019 at the .1 level. V007 and V015 are insignificant. The regression equation is:

$$V004 = 22.5V007 - 29.74V015 + 47.41V018 + 45.87V022 - 50.3V017$$
$$+ 35.33V009 - 30.93V014 + 25.86V024 - 9.34V011 + 34.54V021$$
$$- 29.29V020 + 9.3V013 - 17.26V016 + 12.4V008 - 7.35V006$$
$$- 6.84V019 + 21.31$$

V018 and V019 do not appear in the regression equation under the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1). In both equations, none of the BETA coefficients are significant. Although regression is feasible for question 1 of manufacturing sectors, little can be said about the strength and direction of the relationship between V004 and V006 to V024 inclusive.

Question 2: Manufacturing Sectors

The regression equation for manufacturing sectors without scale transformation has a medium R square value of .4178. All variables in the equation are significant at the .01 level. The regression equation is:

$$V004 - 36.96V039 - 55.09V042 + 74.48V037 - 22.57V036 + 19.74V041$$
$$- .41V035 + 15.26V032 - 19.28V028 + 30.17V043 - 32.25V030$$
$$+ 12.63V026 + 17.5V031 - 18.24V029 - 23.69V033 - 24.13V034$$
$$+ 1041V038 + 13.88V040 + 6.92V025 \_ 49.68.$$

The BETA coefficients of VO42 and VO37 from the above equation are
similar in sign and magnitude under the scale transformation
(0,.33, .66, 1) to (0, .5, .66, 1):

Variable	BETA
VO42: Absence of traffic congestion	-.30
VO37: Cost of utilities	.46

As VO37 increases and VO42 decreases in importance in the decision
for manufacturing sectors to relocate outside the Region, plant size
or the number of employees, VO04, increases. Since similar results
(except for VO26) exist under the scale transformation, it is reason-
able to suggest that regression is feasible with the manufacturing
sectors subpopulation for question 2.

Question 1: Retail Sectors

The regression equation for retail sectors without scale
transformation has a high R square value of .9974; all of the vari-
ables considered in the equation are significant at the .01 level.
The regression equation is:

$$VO04 = 256.34VO12 + 205.42VO22 - 517.87VO20 + 530.21VO09 - 405.17VO17$$
$$+ 391.08VO21 + 271.92VO16 + 284.23VO - 67.57VO19 + 18.64VO14$$
$$- 1810.55$$

The regular regression coefficients are significant (i.e. $F \geqslant 4$) and
their signs may be interpreted with confidence for all variables
except VO14 in the above equation. VO19, VO09, and VO06, although
significant, are excluded because they do not appear in the regression
equation under scale transformation. The BETA coefficients are:

Variable	BETA
V012: Rail transportation	.43
V022: Availability of large tracts of land	.29
V020: Availability of amenities in the region	-.64
V017: Local government attitude to industry	-.6
V021: Availability of housing for employees	.51
V016: Construction costs	.47

As (V012, V022, V021, and V016 increase in importance and V020 and V017 decrease in importance for retail sectors to locate in the G.V.R.D., plant size or the number of employees, V004, increases. Of the 15 variables which appear in the regression equation under the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1), 8 variables do not appear in the above equation. This suggests that a significant amount of change occurs between the two regression equations; the above results are at best acceptable.

Question 2: Retail Sectors

The regression equation for retail sectors without scale transformation has a high R square value of .9993; all of the variables considered in the equation are significant at the .01 level. The regression equation is:

$$V004 = 474.8V041 - 694.95V027 + 731.48V028 - 315.77V040 - 231.47V029$$
$$+ 57.67V026 + 7.01V025 + 524.53$$

The regular regression coefficients are significant (i.e. $F \geqslant 4$) and their signs may be interpreted with confidence for all variables except V025 in the above equation. Only V041 and V040 are reviewed because other significant variables do not appear in the regression

equation under scale transformation. The BETA coefficients are:

Variable	BETA
V041: Availability of large tracts of land	.77
V040: Availability of amenities in the region	-.36

As V041 increases and V040 decreases in importance for retail sectors to relocate outside the Region, plant size or the number of employees, V004, increases. Although the regression equation under the scale transformation (0, .33, .66, 1) to 0, .5, .66, 1) is somewhat different from the above equation, the above results are considered acceptable.

Question 1: Wholesale Trade and Storage Sectors

The regression equation for wholesale sectors without scale transformation has a high R square value of .9289; all of the variables in the equation are significant at the .01 level. The regression equation is:

$$V004 = 319.81V022 - 75.54V013 - 66.3V023 - 84.22V020 + 44.78V024$$
$$+ 100.22V011 - 45.15V012 - 42.54V016 - 22.77V006 + 46.73V018$$
$$- 20.24V008 + 73.84V021 - 27.27V019 - 15.93V015 - 110.63$$

The regular regression coefficients are significant (i.e F ≥ 4) and their signs may be interpreted with confidence for V022, V013 and V011. The BETA coefficients are:

Variable	BETA
V022: Availability of large tracts of land	1.06
V013: Water transportation	- .34
V011: Truck transportation	.45

As V022 and V011 increase and V013 decreases in importance in the decision for wholesale sectors to locate in the G.V.R.D., plant size

or the number of employees, V004, increases. Of the 17 variables which appear in the regression equation under the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1), 8 variables do not appear in the above equation. This suggests that a significant amount of change occurs between the two regression equations; the above results are common to both equations.

Question 2: Wholesale trade and storage sectors

The regression equation for wholesale sectors without scale transformation has a high R square value of .9899; all variables in the equation are significant at the .01 level. The regression equation is:

$$V004 = 399.67V041 - 204.57V043 - 71.62V028 - 382.13V032 + 734.85V034$$
$$- 297.98V035 + 333.74V036 - 212.08V039 + 75.1V040 - 54.38V026$$
$$+ 273.88V042 - 537.87V037 - 161.21V025 - 291.84V033 + 133.88V031$$
$$- 108.2V029 + 71.23V027 + 469.94$$

The regular regression coefficients are significant (i.e. $f \geqslant 4$) and their signs may be interpreted for all variables in the above scales. V036 is excluded from the analysis however, because it is insignificant for wholesale sectors under the scale transformation. V026, V042, V031, V029 and V027 are also excluded because their coefficients differ in sign and magnitude from the transformed regression equation. The BETA coefficients considered are:

Variable	BETA
V041: Availability of large tracts of land	1.66
V043: High quality environment	- .70
V028: Employee wage scales	- .29
V032: Water transportation	- 1.8

Variable		BETA
VO34:	Land prices or lease rates	2.72
VO35:	Construction costs	-1.32
VO39:	Availability of housing for employees	- .82
VO40:	Availability of amenities in region	.28
Vo37:	Cost of utilities	-2.29
VO25:	Nearness to markets	- .66
VO33:	Air transportation	-1.3

As VO41, VO34 and VO40 increase and VO43, VO28, VO32, VO35, VO39, VO37, VO25, and VO33 decrease in importance in the decision for wholesale sectors to relocate outside the Region, plant size or the number of employees, VO04, increases. Since similar results (except for VO36) exist for wholesale sectors under the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1), it is reasonable to suggest that regression is feasible with the wholesale subpopulation for question 2.

Question 1: Infrastructure

The regression equation for infrastructure categories without scale transformation has a high R square value of .99998. All of the variables in the equation are significant at the .01 level except VO16 and VO20 which are respectively significant at the .05 and .1 levels. The regression equation is:

$$VO04 = 384.52VO20 - 1297.31VO16 + 794.58VO23 + 211.11VO08 - 148.93VO13$$
$$- 136.86VO18 + 63.18VO19 + 205.57$$

The regular regression coefficients are significant (i.e. $F \geqslant 4$) and their signs may be interpreted with confidence for all variables in the above equation. However, only VO08 has a significant BETA

value of similar sign and magnitude in the transformed regression

equation as well. The BETA coefficient is:

Variable   BETA

V008: Skilled labour supply   .50

As V008 increases in importance in the decision for infrastructure

sectors to locate in the G.V.R.D., plant size or the number of em-

ployees, V004, increases. Significant change occurs in the regression

equation under the scale transformation (0, .33, .66, 1) to

(0, .5, .66, 1). This suggests that regression is not very feasible

for question 1 of the infrastructure sectors yet the above result

is salvagable.

No regressions were performed for question 2 of infrastructure

firms because only 6 cases are available. Thus, any results would be

quite worthless with this data constraint.

Question 1: Financial and administrative service sectors

The regression equation for financial sectors without scale

transformation has a low R square value of .1687. Linear regression

exists for all variables in the equation at the .05 level except

V019 and V022 at the .01 level and V015, V018, V017, V021 and V007

at the .1 level. The regression equation is:

$$V004 = .38.57V024 + 26.16V019 + 34.87V022 - 22.31V016 + 13.04V008$$
$$- 14.81V020 + 13.65V009 - 50.79V011 + 39.65V012 + 20.07V023$$
$$- 13.69V015 + 18.57V018 - 10.4V017 + 11.64V021 - 8.28V007$$
$$+ 59.62$$

The regular regression coefficient is significant (i.e. F > 4) and

its sign may be interpreted with confidence for V024. The BETA

coefficient is:

Variable	BETA
V024: High quality environment	-.28

As V024 decreases in importance in the decision for financial sectors to locate in the G.V.R.D., plant size or the number of employees, V004, increases. Since similar results exist for financial sectors under the scale transformation (0, .33, .66, 1) to (0, .5, .66, 1), it is reasonable to suggest that regression is feasible with the financial sectors subpopulation for question 1.

Question 2: Financial and administrative service sectors

The regression equation for financial sectors without scale transformation has a low R square value of .2864. Linear regression exists for all variables in the equation at the .01 level. The regression equation is:

$$V004 = 121.6V031 - 76.54V030 - 42.94V029 + 33.91V038 + 29.56V026$$
$$- 33.31V037 + 18.64V036 - 27.93V043 + 16.18V035 + 6.32V040$$
$$+ 5.38V025 + 11.26V042 - 4.95V027 + 7.33V033 - 7.35V039 - 19.6.$$

The regular regression coefficients are significant (i.e. $F > 4$) and their signs may be interpreted with confidence for V031, V030, and V029. However V030's BETA coefficient differs in size and sign and V029 has an insignificant F value under the regression transformation. The BETA coefficient is:

Variable	BETA
V031: Rail transportation	.54

As V031 increases in importance in the decision for financial sectors to relocate outside the Region, plant size or the number of employees, V004, increases. Since similar results exist for financial

sectors under the scale transformation (0, .33, .66, 1) to

(0, .5, .66, 1), it is reasonable to suggest that regression is

feasible with the financial sectors subpopulation for question 2.

G. Summary of Results Derived from the Data

Approximately one-half of the questionnaire variables are

important in the interregional location and relocation decisions for

manufacturing, wholesale, retail and all sectors. Using Spearman rank

correlation coefficients, it is evident that only the primary and

infrastructure sectors display a relatively dissimilar response

pattern between questions 1 and 2.

All subpopulations at the intrametropolitan level, on the basis

of the data are centrally located in terms of frequency. In general,

larger firms locate centrally ; small firms locate peripherally. There

is some indication that larger firms locate centrally for primary and

retail sectors; no definite relationship exists for manufacturing

firms with respect to location and size. Some tendency exists for

larger wholesale firms to locate centrally. Smaller firms locate

centrally for the infrastructure and administrative sectors.

The regression analysis is interpreted in conjunction with

the above size/location relationships.

1. All Sectors: As V022 and V009 increase and V017 decrease

in importance in the decision to locate in the G.V.R.D., plant size

or the number of employees, V004, increases. V041, V026, and V033

increase and V043 decreases in importance in the decision to re-

locate outside the Region, as V004 increases.

2. Primary Sectors: As V019, V015, V011 and V022 increase

and V017, V010, and V013 decrease in importance in the decision to locate in the G.V.R.D., V004 increases. V026 increases and V036 and V033 decrease in importance in the decision to relocate outside the Region, as V004 increases.

3. <u>Manufacturing Sectors</u>: Although regression is feasible for question 1 of manufacturing sectors, little can be said about the strength and direction of the relationship between V004 and V006 to V024 inclusive in the decision to locate in the G.V.R.D. As V037 increases and V042 decreases in importance in the decision to re-locate outside the Region, V004 increases.

4. <u>Retail Sectors</u>: As V012, V022, V021 and V016 increase and V020 and V017 decrease in importance in the decision to locate in the G.V.R.D., V004 increases. V041 increases and V040 decreases in im-portance in the decision to relocate outside the Region, as V004 increases.

5. <u>Wholesale Trade and Storage Sectors</u>: As V022 and V011 in-crease and V013 decreases in importance in the decision to locate in the G.V.R.D., V004 increases. V041, V034 and V040 increase and V043, V028, V032, V035, V039, V037, V025 and V033 decrease in importance in the decision to relocate outside the Region, as V004 increases.

6. <u>Infrastructure</u>: As V008 increases in importance in the decision to locate in the G.V.R.D., V004 increases. Due to insuf-ficient data, no regressions were performed for question 2.

7. <u>Financial Sectors</u>: As V024 decreases in importance in the decision to locate in the G.V.R.D., V004 increases. V031 in-creases in importance in the decision to relocate outside the Region, as V004 increases.

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[10]Nie, N. H.,Bent, D. H., and Hull, C.H., Op. cit., p. 184.

[11]_Ibid._, p. 144.

[12]_Ibid._, p. 153.

[13]Russel, R., Op. cit., p. 33.

[14]Siegel, S., _Nonparametric Statistics for the Behavioural
Sciences_ (New York: McGraw-Hill Book Company, 1956) p. 26.

[15]The author wishes to express his sincere thanks to Professor
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CHAPTER VI

SUMMARY AND RECOMMENDATIONS WITH SUGGESTIONS
FOR FURTHER RESEARCH

A. Summary

This study empirically determines which questionnaire variables (factors) influence the relative location/relocation of various firms located in the G.V.R.D. The location survey questionnaire comprises a portion of the IIPS project which is a large-scale, special research study of the Region. The statistical analysis and regression models of the present location survey questionnaire study provide an empirical data base for the land use group in their development of models which allocate economic activities across the Region. It is noted that Metropolitan Vancouver's unique site qualities characterize its "core-ring" spatial form.

The thesis derives some general interregional results although the data is extensively utilized in a decidedly intrametropolitan context. The interregional results depict which variables are important in the location and relocation decisions for each subpopulation. In contrast, an empirical basis for intrametropolitan business location policy in the G.V.R.D. is derived from the analysis herein. The intrametropolitan analysis is feasible because size (i.e. number of employees) and location are known for most respondents. An empirical synthesis via some common independent variables is suggested to

exist, at least for the G.V.R.D., between interregional and intra-metropolitan location. This will aid in the construction of future questionnaire studies for each subpopulation at the interregional or intrametropolitan levels in the G.V.R.D.

Aside from the empirical value, this thesis is valuable in terms of methodological and analytical procedure. Modifications of the location survey procedure and format suggested in the text are applicable to business location surveys in general. The regression transformation technique is applicable to other questionnaire studies where the type of response scale constructed is in question.

Furthermore, the overview of location theory and Metropolitan Vancouver are thought to provide an appropriate background to this study as well as represent a substantial literary contribution.

The first chapter provides an introduction to the study as well as a brief overview of interregional location theory. Chapter II briefly reviews some of the rather extensive, major theories which underlie the intrametropolitan location theory of certain firms. The third chapter presents an historical, economic and business sector synopsis of Metropolitan Vancouver. This synopsis outlines some topics which are relevant to the present location/relocation, questionnaire study of firms located in the G.V.R.D.:

- historical development, spatial form and site qualities;

- land jurisdiction and ownership; and

- population and economic development.

Very brief consideration is given to the intrametropolitan location theory of each subpopulation. Chapter IV considers the location survey questionnaire in the context of the IIPS project. Discussion of the questionnaire technique and the specific variables used in the

present study are a prelude to the statistical analysis of the
questionnaire data in Chapter V. The fifth chapter explains the
general method and summarizes the significant analytical results of
the location survey questionnaire. It is unnecessary to summarize
these results again. In addition to this chapter, five appendices
are further presented.

B. Assessment of Project Worth and Recommendations

This study is valuable because its statistical analysis
and regression models provide an empirical data base for the land use
group of the IPPS project in their development of models which allocate
economic activities across the Region. Aside from the empirical value,
this thesis is valuable in terms of methodological and analytical pro-
cedure. The overview of location theory and Metropolitan Vancouver
also represents a substantial literary contribution. Nevertheless,
there are some deficiencies to which the following recommendations
are pertinent.

The principal shortcoming of this case study is that the poor
response rate and missing values inhibit inferences about the location/
relocation of some subpopulations. These two defects could be rectified
by contacting a larger number of firms and stating on the questionnaire
that unanswered factors are considered as "1. unimportant".

The following suggestions might have improved the quality,
reliability and completeness of the questionnaire returns, given the
poor response rate of the mailed survey.

1. A simple notice such as, "There are two different questions,
please answer both sides of this survey" printed on both sides of
the questionnaire might have caused more complete responses.

2.   The location survey questionnaire should have been mailed

separately from the input-output questionnaire. Although this en-

tails greater expense, the low response to the input-output question-

naire would not impair responsiveness to the location survey

questionnaire.

3.   Although a personally administered questionnaire is far more

time consuming than mailed questionnaires, the quality, reliability

and completeness of the questionnaires are more controlled via personal

rather than written contact with prospective respondents. For

example, the researcher could administer the questionnaire only to

people responsible for determining the firm's present location.

Personal factors, although of a qualitative nature, could be identified

under the variable "Other (please specify)". The variability and

magnitude of the personal factors would set a subjective constraint

on data interpretation. If the same personal factor occurs on several

questionnaires, this factor would appear in subsequent questionnaire

studies. A personal interview also enables elaboration on which

aspects of a particular factor, i.e. high quality environment, are

important, as well as clarification of any misunderstandings about

the questionnaire.

4.   More precise definition of the factors is required in future

studies. For example, is the factor "Truck transportation" used in

the context of availability of, cost of, or both? Is the "Availability

of large tracts of land" required for a large plant, onsite expansion,

or both?

5.   This study is severely limited because it is unknown when

the decision was made by firms to locate in the G.V.R.D. Consequently,

there should be a question which determines when the firm established

operations in the G.V.R.D. The answer would provide a reliability

index to question 1. Indeed, it is doubtful whether a 30 year old

firm could honestly answer question 1 and even if it could, the

reasons for initially locating are not necessarily the reasons for

maintaining the same location. There should also be a sequel to

question 1 which reads: "For each of the following factors would

you please indicate the level of importance in your decision to

presently remain located in the Vancouver Region." Significant

differences between this and question 1 would reveal when the

degree of irrelevency between former and present decisions becomes

significant. Thus, only recently, i.e. 7 years or less, say, located

firms would be analyzed.

6.   A question should be included which asks whether respondents

actually intend to move. The hypothesis that older firms are more

dissatisfied with their present location than newer firms could

then be tested. Conditional to firms answering "yes" to this

question, they should be asked the municipality, province or

country to which they plan to move. In this regard, question 2

should be re-phrased to read, "If you were to move within the

Vancouver Region, would you please indicate the level of importance

of the following factors in your decision to relocate." Thus,

intrametropolitan movement trends by size classes and industry sub-

population could aid the land use group in their development of

models which allocate economic activities across the Region.

7.   Question 1 asks respondents to consider the importance of

nineteen location factors in their decision to locate in the Vancouver

Region. All of these factors have potential to spatially vary in

an intrametropolitan context. Question 1 is interregional in nature

because the VMIS considers the regional economy as a point in space.
However, intrametropolitan analysis of the location survey question-
naire is possible because the precise location for most firms is
known. Thus, spatial analysis of the variation of these factors for
a given subpopulation within the Region is feasible. This limited
approach to empirically assess intrametropolitan location can be
improved if a supplement to question 1 states, "For each of the
following factors would you please indicate the level of importance
in your decision to locate your business in the particular municipal-
ity in the Vancouver Region." Thus, the importance of the location
factors at the regional and intrametropolitan levels could be fully
established and compared.

C. Suggestions for Further Research

The intrametropolitan dynamics of several subpopulations is
largely unresearched for Metropolitan Vancouver. Locational dynamics
refers to the net change in the number of firms in an area over time
and is expressed as follows:

$$c = b - d + m - e$$

where   c = net change in number of plants

b = plant births

d = plant mortalities

m = plants migrating into the area

e = plants migrating out of the area.

In particular, intertemporal analysis of which factors influence the
different subpopulations to relocate within the Region would greatly
assist the land use group in their development of a dynamic model of

intrametropolitan location. The role of business as a source of municipal revenue and the impact which business has upon the spatial form of the G.V.R.D. are further reasons to assess the form, extent and composition of the intrametropolitan locational dynamics of each subpopulation.

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APPENDIX I

Business Sectors in the Vancouver Metropolitan Input-Output Study

Sector 1: Agriculture and Fishing

1.1: Livestock and Crop Farms

Includes: SIC011 - Livestock and livestock combination farms.
SIC013 - Field crop and field crop combination farms.
SIC015 - Fruit and vegetable farms.
SIC017 - Other crop and livestock combination farms.

1.2: Specialty Farms and Services

Includes: SIC019 - Miscellaneous livestock and nursery specialty farms.
SIC021 - Services incidental to agriculture (veterinary, hospital, hatchery, grading, spraying, etc.)

1.2: Fishing and Hunting

Includes: SIC041 - Commercial fishing operations
SIC045 - Fishery services (breeding, hatching, fishing gear repair, etc.)
SIC047 - Commercial hunting and trapping

Sector 2: Mining

2.1: Copper, Lead and Zinc

Includes: SIC059 - Miscellaneous metal mines

2.2: Other Mines and Services

Includes: SIC051 - Placer gold mines
SIC052 - Gold quartz mines
SIC057 - Uranium mines
SIC058 - Iron mines
SIC059 - Miscellaneous metal mines

SIC061 - Coal mines
SIC064 - Crude petroleum and natural gas industry

SIC071 - Asbestos mines
SIC072 - Peat extraction
SIC073 - Gypsum mines
SIC079 - Miscellaneous non-metal mines

SIC083 - Stone quarries
SIC087 - Sand pits or quarries

                         SIC096 - Contract drilling for petroleum
                         SIC098 - Other contract drilling
                         SIC099 - Miscellaneous services incidental to
                                  mining

Sector 3: Forestry

3.1: Logging and Services

Includes: SIC031 - Logging (cutting, booming, hauling)
           SIC039 - Forestry services (fire protection,
                    reforestration, etc.)

Sector 4: Construction

4.1: Building Construction

Includes: SIC404 - Construction, alterations and repairs

4.2: Highway Construction

Includes: SIC406 - Construction and repair of highways,
                    bridges and streets

4.3: Special Trade Contractors

Includes: SIC409 - Sub-trade contractors
           SIC421 - Special-trade contractors

Sector 5: Food and Beverages

5.1: Meat, Poultry and Fish Products

Includes: SIC101 - Processing, preparing, and packing
                    of meat and poultry products
           SIC102 - Processing, preparing and packing of
                    fish products.

5.2: Dairy Products

Includes: SIC104 - Processing and packing (milk, butter,
                    cheese, ice cream, etc.)

5.3: Fruit and Vegetable Processing

Includes: SIC103 - Drying, canning and freezing of fruit
                    and vegetables

5.4: Flour and Cereal Products

Includes: SIC105 - Flour and breakfast cereal products
                    industry
           SIC106 - Feed industry

5.5: <u>Beverage Industry</u>

Includes: SIC109 - Manufacturing and distilling (malts, liquors, wines, soft drinks, etc.)

5.6: <u>Other Food Industries</u>

Includes: SIC107 - Bakery products industries
SIC108 - Miscellaneous food industries (manu-facturing confections, oils, seasonings, sugar, etc.)

Sector 6: <u>Wood Industries</u>

6.1: <u>Milling</u>

Includes: SIC251 - Sawmills, planing mills and shingle mills

6.2: <u>Veneer and Plywood Mills</u>

Includes: SIC252 - Plywood and veneer mills

6.3: <u>Sash, Door and Other Millwork</u>

Includes: SIC254 - Manufacturing (door, sash, moulding, floorings, partitions, kitchen-cabinets, pre-fabricated buildings, etc.

6.4: <u>Other Wood Products</u>

Includes: SIC256 - Wooden box factories
SIC258 - Coffin and casket industry
SIC259 - Miscellaneous wood industries (poles, fences, etc.)

Sector 7: <u>Paper and Allied Industries</u>

7.1: <u>Pulp and Paper Mills</u>

Includes: SIC271 - Pulp and paper mills; building paper mills

7.2: <u>Other Paper Manufacturers and Converters</u>

Includes: SIC272 - Asphalt roofing manufacturers
SIC273 - Paper box and bag manufacturers
SIC274 - Miscellaneous paper converters

Sector 8: <u>Chemical and Chemical Product Industries</u>

8.1: <u>Industrial Inorganic and Organic Chemicals</u>

Includes: SIC372 - Manufacturers of mixed fertilizers
SIC378 - Manufacturers of industrial chemicals

8.2:   Other Chemicals

      Includes: SIC373 - Manufacturers of plastics and synthetic
                         resins
                 SIC374 - Manufacturers of pharmaceuticals and
                         medicines
                 SIC375 - Paint and varnish manufacturers
                 SIC376 - Manufacturers of soap and cleaning
                         compounds
                 SIC377 - Manufacturers of toilet preparations
                 SIC379 - Miscellaneous chemical industries (waxes,
                         pesticides, etc.)

Sector 9:   Petroleum and Coal Products

9.1:   Petroleum and Coal Products

      Includes: SIC365 - Petroleum refineries
                 SIC369 - Miscellaneous petroleum and coal products
                         industries

Sector 10: Non-Metallic Mineral Products

10.1:   Glass and Cut Stone Products

      Includes: SIC353 - Stone products manufacturers
                 SIC356 - Ready-mix concrete manufacturers
                 SIC357 - Abrasives manufacturers

10.2:   Cement, Clay, Concrete, Gypsum and Plaster Products

      Includes: SIC351 - Clay products manufacturers
                 SIC352 - Cement manufacturers
                 SIC354 - Concrete products manufacturers
                 SIC355 - Ready-mix concrete manufacturers
                 SIC358 - Lime manufacturers
                 SIC359 - Miscellaneous non-metallic mineral
                         products industries

Sector 11: Metal Fabricating Industries

11.1:   "Heavy" Fabricated Metal Products

      Includes: SIC301 - Boiler and plate works
                 SIC302 - Fabricated structural metal industry
                 SIC303 - Ornamental and architectural metal
                         industry
                 SIC307 - Heating equipment manufacturers

11.2:   "Light" Fabricated Metal Products

      Includes: SIC304 - Metal stamping, pressing and coating
                         industry
                 SIC305 - Wire and wire products manufacturers
                 SIC306 - Hardware, tool and cutlery manufacturers

SIC308 - Machine shops
SIC309 - Miscellaneous metal fabricating
industries

Sector 12: Printing, Publishing and Allied Industries

12.1: Printing, Publishing and Allied Industries

Includes: SIC286 - Commercial printing
SIC287 - Platemaking, typesetting and trade
bindery industry
SIC288 - Publishing only
SIC289 - Publishing and printing

Sector 13: Manufacturing, Not Elsewhere Classified

13.1: Apparel and Fabricated Textile Products

Includes: SIC187 - Canvas products, and cotton and jute
bags industries
SIC245 - Children's clothing industry
SIC248 - Foundation garment industry

13.2: Furniture and Fixtures

Includes: SIC264 - Office furniture manufacturers
SIC268 - Electric light and shade manufacturers

13.3: Other Manufacturing

Includes: SIC087 - Sand pits or quarries
SIC162 - Rubber products industries
SIC165 - Plastics fabricating industry
SIC243 - Men's clothing industries
SIC244 - Women's clothing industries
SIC246 - Fur goods industry
SIC249 - Miscellaneous clothing industries
SIC261 - Household furniture manufacturers
SIC266 - Miscellaneous furniture and fixtures
manufacturers
SIC291 - Iron and steel mills
SIC315 - Miscellaneous machinery and equipment
manufacturers
SIC321 - Aircraft and aircraft parts manufacturers
SIC323 - Motor vehicle manufacturers
SIC324 - Truck body and trailer manufacturers
SIC327 - Shipbuilding and repair
SIC333 - Manufacturers of lighting fixtures
SIC335 - Communications equipment manufacturers
SIC336 - Manufacturers of electrical industrial
equipment
SIC391 - Scientific and professional equipment
industries

Sector 14:   Retail Trade

14.1:   Retail Trade

Includes: SIC631 - Food stores
SIC642 - General merchandise stores
SIC652 - Tire, battery and accessories stores
SIC656 - Motor vehicle dealers
SIC658 - Motor vehicle repair shops
SIC663 - Shoe stores
SIC665 - Men's clothing stores
SIC667 - Women's clothing stores
SIC669 - Clothing and dry goods stores
SIC673 - Hardware stores
SIC676 - Household furniture and appliance stores
SIC678 - Radio, television and electrical appliance
repair shops
SIC681 - Drug stores
SIC691 - Book and stationery stores
SIC692 - Florists' shops
SIC694 - Jewellery stores
SIC695 - Watch and jewellery repair shops
SIC696 - Liquor, wine and beer stores
SIC697 - Tobacconists
SIC699 - Retail stores, n.e.s.
SIC869 - Miscellaneous services to business
management

Sector 15:   Wholesale Trade and Storage

15.1:   Wholesale Trade

Includes: SIC109 - Beverage industries
SIC264 - Office furniture manufacturers
SIC335 - Communications equipment manufacturers
SIC391 - Scientific and professional equipment
industries
SIC602 - Wholesalers of farm products
SIC606 - Wholesalers of coal and coke
SIC608 - Wholesalers of petroleum products
SIC611 - Wholesalers of paper and paper products
SIC612 - Wholesalers of general merchandise
SIC614 - Wholesalers of food
SIC615 - Wholesalers of tobacco products
SIC616 - Wholesalers of drugs and toilet
preparations
SIC617 - Wholesalers of apparel and dry goods
SIC618 - Wholesalers of household furniture
and furnishings
SIC619 - Wholesalers of motor vehicles and
accessories
SIC621 - Wholesalers of electrical machinery,
equipment and supplies
SIC622 - Wholesalers of farm machinery and
equipment

                    SIC623 - Wholesalers of machinery and equip-
                             ment, n.e.s.
                    SIC625 - Wholesalers of metal and metal products
                    SIC626 - Wholesalers of lumber and building
                             materials
                    SIC627 - Wholesalers of scrap and waste materials
                    SIC629 - Wholesalers, n.e.s.

Sector 16: Transportation and Communication

    16.1: Railroad Transport

            Includes: SIC503 - Railway transport (passenger and freight
                                transport, railroad ferry operation, etc.)

    16.2: Water Transport

            Includes: SIC504 - Water transport (barge, ferry, freight,
                                towing, shipping, etc.)
                       SIC505 - Services incidental to water transport
                                (boathouse service, longshoring,
                                maintenance, etc.)

    16.3: Air Transport

            Includes: SIC501 - Air transport (passenger and freight
                              -- transport, air taxi)
                       SIC502 - Services incidental to air transport
                                (aircraft rental and servicing, terminal
                                service, flying club or school)

    16.4: Motor Transport, Pipelines and Transportation Services

            Includes: SIC506 - Moving and storage, used goods, uncrated
                       SIC507 - Other truck transport
                       SIC508 - Bus transport, interurban and rural
                       SIC509 - Urban transit systems
                       SIC512 - Taxicab operations
                       SIC515 - Pipeline transport
                       SIC516 - Highway and bridge maintenance
                       SIC517 - Miscellaneous services incidental to
                                transport
                       SIC519 - Other transportation

    16.5: Radio and Television Communication

            Includes: SIC543 - Radio and television broadcasting

    16.6: Telephone and Telegraph Communication

            Includes: SIC544 - Telephone systems
                       SIC545 - Telegraph and cable systems

16.7: Other Transportation and Communication

Includes: SIC335 - Communications equipment manufacturers
SIC527 - Other storage and warehousing
SIC574 - Gas distribution

Sector 17: Electric Power, Gas and Water Utilities

17.1: Electric Companies and Systems

Includes: SIC572 - Electric power generation, transmission
and distribution

17.2: Gas Companies and Systems

Includes: SIC574 - Natural or manufactured gas distribution
to consumers

17.3: Water Supply, Irrigation, Sanitary Services

Includes: SIC576 - Water supply processing and distribution;
irrigation systems operation, heating
plant
SIC579 - Other utilities, i.e. refuse disposal
(garbage, ash, sewage, etc.)

Sector 18: Finance, Insurance and Real Estate

18.1: Finance

Includes: SIC701 - Banks and other deposit accepting
establishments
SIC703 - Other credit agencies
SIC705 - Security brokers and dealers (including
Exchanges)
SIC707 - Investment and holding companies

18.2: Insurance

Includes: SIC721 - Insurance carriers (automobile, fire,
health, life, mortgage guaranty,
pension, etc.)

18.3: Real Estate

Includes: SIC735 - Insurance and real estate agencies
SIC737 - Real estate operators

Sector 19: Personal Services

19.1: Personal Services

Includes: SIC399 - Miscellaneous manufacturing industries,
n.e.s.

                    SIC871 - Shoe repair shops
                    SIC872 - Barber and beauty shops
                    SIC873 - Private households
                    SIC874 - Laundries, cleaners and pressers
                             (except self-service)
                    SIC876 - Self-service laundries and dry cleaners
                    SIC877 - Funeral services
                    SIC879 - Miscellaneous personal services

Sector 20:   Health and Welfare Services

    20.1:   Health and Welfare

        Includes: SIC631 - Food stores
                    SIC821 - Hospitals
                    SIC822 - Related health care institutions
                    SIC823 - Offices of physicians and surgeons
                    SIC824 - Offices of Para-medical personnel
                             (Practitioners)
                    SIC825 - Offices of dentists
                    SIC826 - Diagnostic and therapeutic services, n.e.s.
                    SIC827 - Miscellaneous health services
                    SIC828 - Welfare organizations

Sector 21:   Education and Related Services

    21.1:   Education and Related Services

        Includes: SIC801 - Kindergartens and nursery schools
                    SIC802 - Elementary and secondary schools
                    SIC803 - Schools of art and of the performing arts
                    SIC804 - Vocational centres, trade schools, and
                             business colleges
                    SIC805 - Post-secondary non-university educational
                             institutions
                    SIC806 - Universities and colleges
                    SIC807 - Libraries, museums and other repositories
                    SIC809 - Education and related services, n.e.s.
                    SIC828 - Welfare organizations

Sector 22:   Services to Business Management

    22.1:   Business Services

        Includes: SIC099 - Miscellaneous services incidental to
                             mining
                    SIC327 - Shipbuilding and repair
                    SIC544 - Telephone systems
                    SIC851 - Employment agencies and personnel
                             suppliers
                    SIC853 - Computer services
                    SIC855 - Security and investigation services
                    SIC861 - Offices of accountants
                    SIC862 - Advertising services
                    SIC863 - Offices of architects

                    SIC864 - Engineering and scientific services
                    SIC866 - Offices of lawyers and notaries
                    SIC867 - Offices of management and business
                             consultants
                    SIC869 - Miscellaneous services to business
                             management
                    SIC895 - Machinery and equipment rental

Sector 23: Amusement, Recreation, Accommdation and Food Services

23.1: Amusement and Recreation Services

        Includes: SIC841 - Motion picture theatres
                   SIC842 - Motion picture production and distribution
                   SIC843 - Bowling alleys and billiard parlours
                   SIC844 - Golf clubs and country clubs
                   SIC845 - Theatrical and other staged entertainment
                            services
                   SIC849 - Miscellaneous amusement and recreation
                            services

23.2: Accommodation and Food Services

        Includes: SIC881 - Hotels and motels
                   SIC883 - Lodging houses and residential clubs
                   SIC884 - Camping grounds and trailer parks
                   SIC886 - Restaurants, caterers and taverns

Sector 24: Federal Administration

24.1: Federal Government

        Includes: SIC902 - Defence administration
                   SIC909 - Other federal administration

        This represents all government departments, services and
agencies in Metropolitan Vancouver and not reported elsewhere.

Sector 25: Provincial Administration

25.1: Provincial Government

        Includes: SIC931 - Provincial administration

        This represents all government departments, services, and
agencies in Metropolitan Vancouver and not reported elsewhere (e.g.
hydro and gas).

Sector 26: Local Administration

26.1: Local Government

        Includes: SIC951 - Local Administration

        This represents all government departments, services and
agencies not reported elsewhere.

Sector 27: Miscellaneous, Not Elsewhere Classified

        Includes: SIC391 – Scientific and professional equipment
                                  industries
                  SIC898 – Services to buildings and dwellings
                  SIC899 – Miscellaneous services, n.e.s.

APPENDIX II

LOCATION AND SIZE OF SELECTED
COMMERCIAL CENTRES – METROPOLITAN VANCOUVER

LOCATION	COMMERCIAL FLOOR SPACE (sq. ft.)
Vancouver	
West End	294,681
Point Grey	211,992
Dunbar	340,359
Kitsilano	1,453,040
Kerrisdale	422,805
Cambie	1,576,713
Oakridge	576,061
Marpole	435,064
Mt. Pleasant	1,897,770
Sunset	770,531
Grandview	574,755
Hastings	531,889
Renfrew	311,321
Kingsway	515,429
Fraserview	437,489
Total for Vancouver	10,350,399
Burnaby	1,951,859
New Westminster	2,105,671
Coquitlam	333,535
Port Moody	86,087
West Vancouver	915,343
North Vancouver City	989,000
Richmond	1,136,721
Delta	470,259
Surrey	
Whalley	716,340
Guildford	508,639
Newton	199,848
Cloverdale	158,190
Sunnyside	120,406
White Rock	268,600
Total (excluding Downtown Vancouver)	20,311,297

Source: Commercial Floor Space, Greater Vancouver Regional District
Planning Department, February, 1970.

PRINCIPAL NON-GOVERNMENT OFFICE BUILDINGS
City of Vancouver, 1967 - 1972

Year Completed	Building	Location	No. of Floors	Rentable Space (sq.ft.)
1967	Bentall Centre (1st Tower)	Pender and Burrary	21	245,000
1967	Royal General Insurance	1155 W. Hastings	8	97,000
1967	Baxter Bldg (Columbia Centre)	1111 W. Hastings	13	90,000
1967	Phillips Building	535 Thurlow	8	67,000
1968	Montreal Trust Building	700 West Pender	15	83,400
1968	Pacific Palisades	747 Bute	3	20,000
1969	MacMillan Bloedel Bldg.	Georgia and Thurlow	27	340,000
1969	Board of Trade Tower (Columbia Centre)	1177 West Hastings	27	286,000
1969	Guinness Tower	1055 West Hastings	23	260,000
1969	Bentall Centre (2nd Tower)	Pender and Burrard	17	170,000
1969	Avord Building	Robson and Hornby	20	130,000
1969	885 Dunsmuir	Hornby and Dunsmuir	10	65,000
1969	Wall & Redekop	1070 West Broadway	3	21,000
1969	Moore Business Forms	Bute and Melville	4	5,000
1970	Cypress Place	Broadway and Cypress	3	20,000
1970	Westcoast Transmission	1300 West Georgia	15	150,000
1971	Toronto-Dominion Tower (Pacific Centre)	Georgia and Howe	30	540,000
1971	1090 West Pender		12	75,000
1971	The 1177 West Broadway		11	50,000
1971	Bank of Montreal	10th and Granville	5	26,000
1971	East Van Medical Building	1750 East 10th Ave	5	33,000
1972	Norwich Union Building	Georgia and Cardero	3	20,000
1972	814 Richards Street Bldg.	814 Richards	4	44,400
1972	Fairmont Willow Medical Dental Building	2525 Willow	8	28,000
1972	Kerrisdale Medical-Dental	42nd and Maple	3	40,000
1972	Sun Alliance Building (2nd stage)	885 Dunsmuir	9	52,000
u/c	Royal Centre	Georgia and Burrard	37	450,000
u/c	Granville Square (Project 200)	Ft. of Granville	28	350,000
u/c	B.C.Automobile Assoc.	Oak and Broadway	9	40,000
u/c	Sandwell & Co.(1st phase)	1550 Alberni	8	90,000
u/c	Bentall Centre (3rd Tower)	Burrard	31	453,000
u/c	B.C.F.P. Building	1050 West Pender	21	250,000
u/c	700 West Pender St.Bldg.	700 West Pender	16	148,000
u/c	805 West Broadway Bldg. (medical-dental)		18	71,500
u/c	1665 West Broadway Bldg.	1665 West Broadway	6	42,300
u/c	Century Plaza (apartments and commercial)	1144 Burrard	30	15,000

u/c under construction in summer of 1972.

PRINCIPAL NON-GOVERNMENT OFFICE BUILDINGS
Greater Vancouver Suburban Areas, 1967 - 1972
(in excess of 5,000 square feet)

Year Completed	Building	Location	No. of Floors	Rentable Space (sq.ft.)
Burnaby				
1968	Edmonds Building	7879 Edmonds	2	14,000
1970	Operating Engineers Union	4333 Ledger	4	16,700
1970	Spectacular Productions	6440 Oak	2	13,200
1971	Allstate Building	3876 Norland Ave.	2	12,000
1972	Highfield Development	4259 Canada Way	2	60,400
1972	Royal Bank Building	7291 Kingsway	2	12,000
1972	Urban Computers	4025 McConnell	1	5,874
1972	North American Life	4221 Kingsway	6	29,500
1972	Heathcote Holdings Ltd.	6545 Bonsor	2	16,000
1972	Plaza 5000	5000 block Kingsway	3	23,200
1972	Buchanan Enterprises	4489 Buchanan	2	25,000
1972	Government Employees Union Building	4929 Canada Way	3	13,000
New Westminster				
1968	Office	313 Sixth Street	2	7,200
1969	Medical Dental	610 Royal Avenue	2	12,600
1969	Commercial and Office	712 Sixth Street	1	5,200
1969	Commercial and Office	765 Sixth Street	2	7,500
1969	Retail and Office	404 Sixth Street	2	8,000
1970	Retail and Office	719 Sixth Street	2	5,000
1972	Retail and Office	450 Sixth Street	2	6,980
Coquitlam				
1967	Caisse Populaire	1013 Brunette Ave	2	5,946
1968	Farwest Investments	1062 Austin Ave	2	5,280
1968	Coquitlam Medical-Dental	218 Blue Mountain St	1	6,153
1969	Offices	946 Brunette Ave	2	5,304
1970	J. Cewe Ltd.	1850 Hillside Ave.	1	9,487
1970	Farwest Investments	1046 Austin Ave.	2	9,570
1970	Dan Bralic	Blue Mountain and Lougheed	2	5,602
Richmond				
1968	B.C. Packers Ltd.	430 Moncton St.	2	15,300
1971	Crestwood Medical Clinic	605 Gilbert Rd.	3	15,850
1972	Canadian Projects Ltd	805 Anderson Rd	3	32,000
1972	Retail and Offices on 2nd floor	605 No. 3 Road	2	13,200
1972	Renovation to offices	818 Park Place	2	16,104
1972	Offices	387 No. 3 Road	2	7,500
1972	Offices	826 Granville Ave	2	9,892
1972	Offices	641 Buswell St.	3	19,016
1972	Offices on 2nd floor	363 No. 3 Road	2	10,000

Greater Vancouver Suburban Areas, 1967-1972 (continued)

Year Completed	Building	Location	No. of Floors	Rentable Space (sq.ft.)
North Vancouver City				
1967	Medical Centre	145 East 13th St	9	29,160
1968	Offices	2601 Westview Dr.	2	10,320
1969	Offices and Apartments	1441 St. Georges Ave.	16	20,626
1970	Offices	140 West 15th St.	2	16,700
1971	Retail, Offices and Apartments	130-148 West 16th St.	14	12,460
1971	Retail and Offices	1133-1139 Lonsdale Ave	2	9,537
1971	Offices	133 West 15th St.	1	10,555
1972	Commercial and Apartments	130-144 West 14th St.	24	5,229
1972	Offices	145 West 15th St.	3	28,020
West Vancouver				
1967-71	Total Office space constructed			30,000

Source: "Office Space Survey, 1972". This survey was conducted by Western Realesearch Corporation Ltd. for the Real Estate Board of Greater Vancouver in Real Estate Trends in Metropolitan Vancouver 1972-1973 (Statistical and Survey Committee, Vancouver: 1972) pp. C-15 to C-17.

Industrial Land Values, 1972

	$ per Square Foot	$ Per acre
Vancouver		
Cambie to Oak (6th to 8th Avenue)	7.00 - 8.00	
Cambie to Main (2nd to 8th Avenue)	5.00 - 6.00	
Powell (south side)	4.00 - 5.00	
South of Powell (Glen-Victoria Dr.)	4.00 - 5.00	
Clark Drive	4.00 - 5.00	
Boundary Road area (poor footings)		40,000 - 50,000
Boundary Road area (good footings)		50,000 - 75,000
Marine Drive area		55,000 - 75,000
Burnaby		
Lougheed Highway (at Boundary Road)		60,000 - 70,000
Lougheed Highway (vicinity of Willingdon)		75,000 - 90,000
Lougheed Highway (areas with poor footings)		40,000 - 50,000
Willingdon area		40,000 - 55,000
Marine Drive area - unprepared		8,000
- serviced and prepared		15,000 - 20,000
Lake City (fully serviced)		50,000 - 60,000
M4 - Beresford area		45,000
North Vancouver*		
Not waterfront and serviced		*25,000 - 40,000
Port Coquitlam		
Acreage (not waterfront)		12,000 - 15,000
Serviced lots	0.50 - 0.80	
Richmond		20,000 - 40,000

*
no recent sales have occurred.

Source: "Office Space Survey, 1972". This survey was conducted by
          Western Realesearch Corporation Ltd. for the Real Estate Board
          of Greater Vancouver in <u>Real Estate Trends in Metropolitan
          Vancouver 1972-1973</u> (Statistical and Survey Committee,
          Vancouver: 1972) p. C-20.

Commercial Land Values, 1972

	$ Per Square Foot
Vancouver	
Financial and Retail Core (area bounded by Hastings-Robson-Seymour-Thurlow):	
Hastings and Pender Streets	35.00 - 55.00
Georgia	50.00 - 75.00
Robson	20.00 - 35.00
Burrard	50.00 - 65.00
Hornby and Howe Streets	25.00 - 50.00
Georgia - west of Thurlow	25.00 - 30.00
Burrard - Smithe to Davie	15.00 - 20.00
Davie, Robson, Denman	15.00 - 30.00
South Granville	20.00 - 25.00
Broadway: Granville-Cambie	12.00 - 15.00
Cambie-Main	8.00 - 12.00
East Hastings - east of Clark Drive	6.00 - 10.00
Kingsway	5.00 - 7.00
Burnaby	
Kingsway: Patterson	6.00 - 7.00
Willingdon	6.00 - 7.00
Sperling	5.00
East Hastings	5.00 - 6.00
North Vancouver	
Upper Lonsdale	9.00 - 15.00
Lower Lonsdale	5.00 - 8.00
North Vancouver: Marine Drive	6.00 - 8.00
West Vancouver: Ambleside-Dundarave	8.00 - 14.00
Richmond: Brighouse	6.00 - 7.00
Surrey: King George Highway	4.00 - 5.00
Coquitlam	
North Road	4.00 - 5.00
Brunette and Austin	3.00 - 4.00
Port Coquitlam: Shaughnessy Street	4.50 - 5.00

Source: "Office Space Survey, 1972". This survey was conducted by Western Realesearch Corporation Ltd. for the Real Estate Board of Greater Vancouver in Real Estate Trends in Metropolitan Vancouver 1972-1973 (Statistical and Survey Committee, Vancouver: 1972) p. C-24.

Industrial Rental Values, 1972

"The following table illustrates rental levels for conventional types of basic space having approximately 10 per cent of the space finished as offices or display areas, ceiling heights of 14 feet, unsprinklered, not on rail, an ordinary identity factor, and bylaw parking and loading facilities only. The higher rate would apply for areas of less than 8,000 square feet and the lower rate would apply for larger areas."

	Rental Value $
False Creek (North and South sides):	
Main to Granville	1.50 - 1.70
Granville to Burrard	1.50 - 1.70
Clark Drive area	1.40 - 1.70
Boundary Road area	1.40 - 1.70
S. E. Marine Drive area	1.40 - 1.70
North Vancouver	1.30 - 1.50
Richmond	1.20 - 1.40
Port Coquitlam	1.20 - 1.40

Source: "Office Space Survey, 1972". This survey was conducted by Western Realesearch Corporation Ltd. for the Real Estate Board of Greater Vancouver in Real Estate Trends in Metropolitan Vancouver 1972-1973 (Statistical and Survey Committee, Vancouver: 1972) p. C-21.

Office Rental Values, 1972

	Rental Range	Vacant
Vancouver		
Downtown Peninsula	2.50 - 8.00	2½ - 3½
Broadway	2.00 - 8.00	4½ - 5½
East Hastings	2.00 - 4.50	3½ - 4½
Fraser	1.50 - 4.00	1 - 2
Main	2.50 - 4.50	2½ - 3½
Kingsway	2.50 - 4.50	1 - 2
Other	2.00 - 7.75	4½ - 5½
	-	3½ - 4½
Total	-	3 - 4
Suburbs		
Burnaby	3.00 - 5.50	4½ - 5½
North Vancouver City	3.500 - 5.50	3 - 4
West Vancouver	3.00 - 6.00	1½ - 2½
Richmond	3.00 - 6.00	5 - 6
	-	4 - 5
TOTAL	-	3 - 4

Source: "Office Space Survey, 1972". This survey was conducted by
Western Realesearch Corporation Ltd. for the Real Estate
Board of Greater Vancouver in Real Estate Trends in Metropolitan
Vancouver 1972-1973. (Statistical and Survey Committee,
Vancouver: 1972) p.

Metropolitan Vancouver Construction Costs per Square Foot
(mid-year)

	1969	1972
Office Buildings		
Wood frame (2 storeys)	13.00 - 16.00	16.00 - 19.00
Concrete		
- up to 8 storeys	19.00 - 24.00	20.00 - 25.00
- up to 20 storeys	22.00 - 27.00	25.00 - 30.00
- over 20 storeys	24.00 - 32.00	27.00 - 35.00
Parking Garages		
Single raised deck with on-grade parking	3.25 - 3.75	3.75 - 4.50
Two or three storeys above and on-grade parking	4.25 - 5.00	5.50 - 6.50
Multi-storey parking	5.50 - 6.50	6.25 - 8.25
Basement parking in conjunction with multi-storey parking or office buildings	7.00 - 9.00	8.00 - 10.00
Shopping Centres		
Concrete department stores	16.50 - 20.00	17.50 - 21.00
Steel frame large area prestige stores	14.00 - 16.50	15.00 - 17.50
Supermarkets	11.00 - 15.00	12.50 - 16.00
Retail unit stores		
- wood frame and block	8.00 - 11.00	10.00 - 13.00
- light steel frame and block	11.00 - 14.00	11.50 - 14.50
Parking areas	0.45 - 0.55	0.45 - 0.60
Light Industrial and Warehouse Buildings		
Wood frame small	5.50 - 7.00	7.50 - 9.50
Steel and concrete block	6.50 - 9.00	8.00 - 10.00
Reinforced concrete	7.50 - 10.00	9.00 - 12.00

Source: "Office Space Survey, 1972." This survey was conducted by
Western Realesearch Corporation Ltd. for the Real Estate
Board of Greater Vancouver in Real Estate Trends in Metropolitan
Vancouver 1972-1973. (Statistical and Survey Committee,
Vancouver: 1972) p. C-27.

APPENDIX III

Table I. Significance Analysis of Questionnaire Variables for
Primary Sectors.

Important			Counterpart Pair	Spearman Correlation	Significance
1.	V008:	92.3%	V006 x V025	.78	.04
2.	V027:	90%			
3.	V006:	84.6%			
4.	V026:	80%			
5.	V007:	76.9%			
6.	V025:	70%			
7.	V036:	70%			
8.	V015:	61.5%			
9.	V017:	61.5%			

Table II. Significance Analysis of Questionnaire Variables
          for Manufacturing Sectors

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	V028: 90.6%	V006: V025	.64	.001
2.	V006: 90%	V007: V026	.70	.001
3.	V026: 89.1%	V008: V027	.90	.001
4.	V025: 87.5%	V009: V028	.30	.022
5.	V029: 87.5%	V010: V029	.40	.002
6.	V036: 87.3%	V011: V030	.82	.001
7.	V007: 87.2%	V015: V034	.43	.001
8.	V030: 85.9%	V016: V035	.46	.001
9.	V034: 85.9%	V017: V036	.46	.001
10.	V011: 83.8%	V018: V037	.48	.001
11.	V035: 82.8%	V020: V039	.66	.001
12.	V037: 82.8%			
13.	V008: 80%			
14.	V027: 76.6%			
15.	V015: 75.6%			
16.	V017: 74.4%			
17.	V018: 73.1%			
18.	V040: 71.9%			
19.	V009: 71.8%			
20.	V010: 70.5%			
21.	V016: 69.2%			
22.	V020: 69.2%			
23.	V039: 67.2%			
24.	V031: 64.1%			
25.	V019: 61.5%			
26.	V042: 60.9%			

Table III. Significance Analysis of Questionnaire Variables for
           Retail Sectors

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	V006: 96.2%	V007 x V026	.88	.001
2.	V025: 94.4%	V008 x V027	.87	.001
3.	V029: 88.9%	V009 x V028	.77	.001
4.	V037: 88.9%	V010 x V029	.55	.035
5.	V040: 88.2%	V011 x V030	.70	.004
6.	V020: 88%	V015 x V034	.83	.001
7.	V008: 87.5%	V017 x V036	.72	.004
8.	V009: 84%	V018 x V037	.57	.028
9.	V010: 84%	V020 x V039	.69	.005
10.	V011: 84%	V021 x V040	.76	.002
11.	V030: 83.3%	V023 x V042	.81	.001
12.	V007: 82.6%	V024 x V043	.67	.012
13.	V035: 82.4%			
14.	V027: 77.8%			
15.	Vo34: 77.8%			
16.	Vo36: 76.5%			
17.	V043: 76.5%			
18.	V018: 76%			
19.	V028: 72.2%			
20.	V015: 72%			
21.	V017: 72%			
22.	V021: 72%			
23.	V042: 70.6%			
24.	V024: 65.2%			
25.	V019: 64%			
26.	V023: 64%			
27.	V026: 61.1%			
28.	V039: 61.1%			

Table IV. Significance Analysis of Questionnaire Variables for
Wholesale Trade and Storage Sectors

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	VO25: 87%	VO06 x VO25	.65	.001
2.	VO34: 87%	VO07 x VO26	.61	.003
3.	VO30: 81.8%	VO11 x VO30	.70	.001
4.	VO31: 78.3%	VO12 x VO31	.70	.001
5.	VO43: 78.3%	VO20 x VO39	.49	.02
6.	VO29: 76.2%			
7.	VOO6: 75.9%			
8.	VO26: 73.9%			
9.	VO40: 73.9%			
10.	VO11: 73.1%			
11.	Vo35: 72.7%			
12.	VO36: 72.7%			
13.	VO12: 71.4%			
14.	VO27: 69.6%			
15.	VO28: 69.6%			
16.	VO39: 65.2%			
17.	VO37: 63.6%			
18.	VO20: 63%			
19.	VOO7: 61.5%			
20.	VO38: 60.9%			

Table V. Significance Analysis of Questionnaire Variables for
          Infrastructure Sectors

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	V006: 86.7%	V006 x V025	.9	.013
2.	V027: 80%	V008 x V027	.92	.028
3.	V008: 70%			
4.	V025: 66.7%			
5.	V007: 63.6%			
6.	V014: 63.6%			
7.	V020: 63.6%			
8.	V021: 63.6%			

Table VI. Significance Analysis of Questionnaire Variables for
           Financial and Administrative Services

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	V006: 81.5%	V006 x V025	.88	.001
2.	V025: 78.3%	V008 x V027	.89	.001
3.	V024: 68.6%	V024 x V043	.89	.001
4.	V027: 67%			
5.	V043: 67%			
6.	V020: 65.8%			
7.	V008: 63.1%			
8.	V040: 62.6%			
9.	V019: 60.3%			

Table VII. Significance Analysis of Questionnaire Variables for
all Sectors

	Important	Counterpart Pair	Spearman Correlation	Significance
1.	V006: 84.2%	V006 x V025	.79	.001
2.	V025: 82.6%	V007 x V026	.79	.001
3.	V026: 76.8%	V008 x V027	.89	.001
4.	V027: 72.5%	V015 x V034	.68	.001
5.	V008: 71.4%	V020 x V039	.51	.001
6.	V036: 70.7%			
7.	V028: 69.2%			
8.	V034: 67.3%			
9.	V020: 67.2%			
10.	V040: 67.1%			
11.	V007: 66.4%			
12.	V043: 62.8%			
13.	V029: 62.7%			
14.	V037: 60.5%			
15.	V015: 60.4%			
16.	V035: t0.3%			
17.	V039: t0.2%			

Table VIII.   Spearman Correlations of Counterpart Variables by
              Subpopulation

1. **Primary Sectors**

	Variable Pair	Correlation	Significance
1.	V006 x V025	.78	.04
2.	V015 x V034	.77	.043
3.	V016 x V035	.94	.002
4.	V019 x V038	.97	.001
5.	V020 x V039	.84	.018
6.	V022 x V041	1.0	.001

2. **Manufacturing Sectors**

	Variable Pair	Correlation	Significance
1.	V006 x V025	.64	.001
2.	V007 x V026	.70	.001
3.	V008 x V027	.90	.001
4.	V009 x V028	.30	.022
5.	V010 x V029	.40	.002
6.	V011 x V030	.82	.001
7.	V012 x V031	.88	.001
8.	V013 x V032	.80	.001
9.	V014 x V033	.86	.001
10.	V015 x V034	.43	.001
11.	V016 x V035	.46	.001
12.	V017 x V036	.46	.001
13.	V018 x V037	.48	.001
14.	V019 x V038	.67	.001
15.	V020 x V039	.66	.001
16.	V021 x V040	.53	.001
17.	V022 x V041	.62	.001
18.	V023 x V042	.38	.003
19.	V024 x V043	.77	.001

Table VIII (continued)

3. Retail Sectors

	Variable Pair	Correlation	Significance
1.	V007 x V026	.88	.001
2.	V008 x V027	.87	.001
3.	V009 x V028	.77	.001
4.	V010 x V029	.55	.035
5.	V011 x V030	.70	.004
6.	V012 x V031	.92	.001
7.	V013 x V032	.87	.001
8.	V014 x V033	.95	.001
9.	V015 x V034	.83	.001
10.	V016 x V035	.69	.005
11.	V017 x V036	.72	.004
12.	V018 x V037	.57	.028
13.	V019 x V038	.65	.009
14.	V020 x V039	.69	.005
15.	V021 x V040	.76	.002
16.	V022 x V041	.60	.017
17.	V023 x V042	.81	.001
18.	V024 x V043	.67	.012

4. Wholesale Trade and Storage

1.	V006 x V025	.65	.001
2.	V007 x V026	.61	.003
3.	V008 x V027	.87	.001
4.	V009 x V028	.69	.001
5.	V010 x V029	.62	.003
6.	V011 x V030	.70	.001
7.	V012 x V031	.70	.001
8.	V013 x V032	.67	.001
9.	V014 x V033	.80	.001
10.	V015 x V034	.70	.001
11.	V016 x V035	.78	.001
12.	V017 x V036	.87	.001
13.	V018 x V037	.85	.001

Table VIII (continued)

	Variable Pair	Correlation	Significance
14.	Vo19 x V038	.75	.001
15.	V020 x V039	.49	.02
16.	V022 x V041	.78	.001
17.	V023 x V042	.90	.001

5. Infrastructure Sectors

	Variable Pair	Correlation	Significance
1.	V006 x V025	.9	.013
2.	V008 x V027	.92	.028
3.	V011 x V030	.82	.045
4.	Vo12 x V031	1.0	.001
5.	V013 x V032	1.0	.001
6.	V022 x V041	1.0	.001

6. Financial and Administrative Services

	Variable Pair	Correlation	Significance
1.	V006 x V025	.88	.001
2.	V007 x V026	.83	.001
3.	V008 x V027	.89	.001
4.	V009 x V028	.68	.001
5.	V010 x V029	.68	.001
6.	V011 x V030	.69	.001
7.	V012 x V031	.84	.001
8.	V013 x V032	.74	.001
9.	V014 x V033	.85	.001
10.	V015 x V034	.71	.001
11.	V016 x V035	.87	.001
12.	V017 x V036	.84	.001
13.	V018 x V037	.81	.001
14.	V019 x V038	.83	.001
15.	V020 x V039	.42	.001
16.	V021 x V040	.57	.001
17.	V022 x V041	.85	.001
18.	V023 x V042	.64	.001
19.	V024 x V043	.89	.001

Table VIII (continued)

7. <u>All Sectors</u>

	Variable Pair	Correlation	Significance
1.	V006 x Vo25	.79	.001
2.	V007 x V026	.79	.001
3.	V008 x V027	.89	.001
4.	V009 x V028	.59	.001
5.	V010 x V029	.66	.001
6.	V011 x V030	.88	.001
7.	V012 x V031	.89	.001
8.	V013 x V032	.78	.001
9.	V014 x V033	.82	.001
10.	V015 x V034	.68	.001
11.	V016 x V035	.74	.001
12.	V017 x V036	.71	.001
13.	V018 x V037	.76	.001
14.	V019 x V038	.75	.001
15.	V020 x V039	.51	.001
16.	V021 x V040	.53	.001
17.	V022 x V041	.77	.001
18.	V023 x V042	.60	.001
19.	V024 x V043	.80	.001

Table IX. Location Frequency Analysis of Primary Sectors.

Location	Absolute Frequency	Relative Frequency(%)
C. B. D.	6	42.9
Vancouver: N.W.	2	14.3
Vancouver: N.E.	1	7.1
Richmond	2	14.3
Surrey	1	7.1
North Vancouver	1	7.1
West Vancouver	1	7.1

    Valid Observations: 14
    Missing Observations: 0

Table X. Location Frequency Analysis of Manufacturing Sectors

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	18	21.2%
Vancouver: N.W.	10	11.8
Vancouver: N.E.	15	17.6
Vancouver: S.W.	1	1.2
Vancouver:S.E.	3	3.5
Richmond	9	10.6
Surrey	5	5.9
Coquitlam	2	2.4
New Westminster	7	8.2
Burnaby S.	10	11.8
North Vancouver	5	5.9

    Valid Observations: 85
    Missing Observations: 0

Table XI. Location Frequency Analysis of Wholesale Trade and
           Storage

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	13	43.3%
Vancouver: N.W.	6	20
Vancouver: N.E.	5	16.7
Vancouver: S.W.	2	6.7
Vancouver: S.E.	1	3.3
New Westminister	1	3.3
Burnaby S.	1	3.3
North Vancouver	1	3.3

Valid Observations: 30

Missing Observations: 0

Table XII. Location Frequency Analysis of Retail Sectors

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	8	30.8%
Vancouver: N.W.	9	34.6
Vancouver: N.E.	2	7.7
Surrey	1	3.8
Burnaby N.	2	7.7
Burnaby S.	3	11.5
West Vancouver	1	3.8

Valid Observations: 26

Missing Observations: 2

Table XIII. Location Frequency Analysis of Infrastructure Sectors

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	6	50 %
Vancouver: S.W.	1	8.3
Richmond	3	25
North Vancouver	1	8.3
West Vancouver	1	8.3

Valid Observations: 12

Missing Observations: 0

Table XIV. Location Frequency Analysis of Financial and Administrative Service Sectors.

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	67	51.5%
Vancouver: N.W.	32	24.6
Vancouver: N.E.	10	7.7
Vancouver: S.W.	3	2.3
Vancouver: S.E.	2	1.5
Richmond	1	.8
Burnaby N.	1	.8
Burnaby S.	5	3.8
Port Moody	1	.8
North Vancouver	4	3.1
West Vancouver	1	.8
U.B.C.	3	2.3

Valid Observations: 130

Missing Observations: 1

Table XV. Location Frequency Analysis of All Sectors

Location	Absolute Frequency	Relative Frequency (%)
C.B.D.	118	39.7%
Vancouver: N.W.	59	19.9
Vancouver: N.E.	33	11.1
Vancouver: S.W.	7	2.4
Vancouver: S.E.	6	2.0
Richmond	15	5.1
Surrey	7	2.4
Coquitlam	2	.7
New Westminster	8	2.7
Burnaby N.	3	1.0
Burnaby S.	19	6.4
Port Moody	1	.3
North Vancouver	12	4.0
West Vancouver	4	1.3
U.B.C.	3	1.0

Valid Observations: 297
Missing Observations: 3

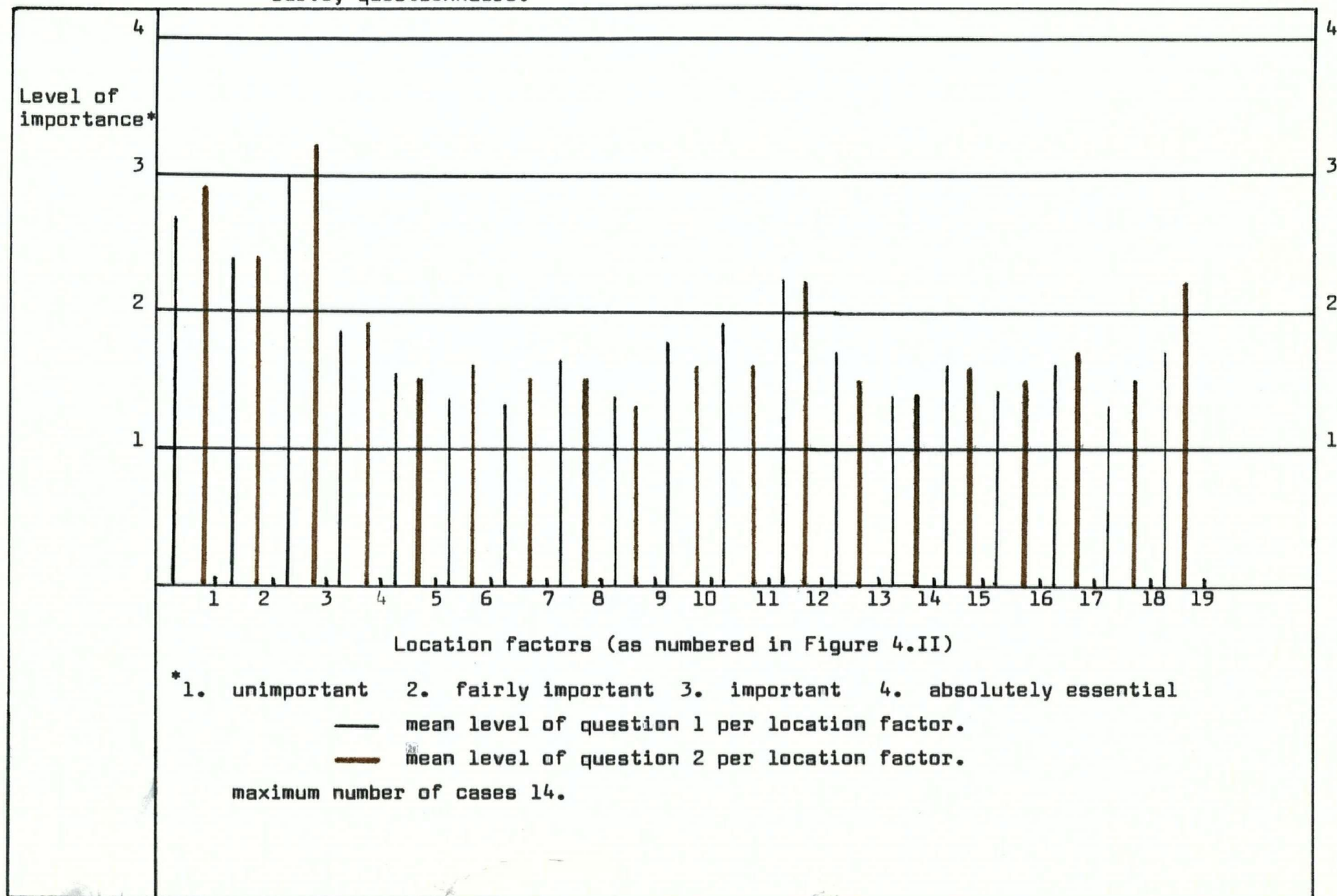Figure I. Primary Sectors: Mean responses to questions 1 and 2 of the location survey questionnaire.

Level of importance*

Location factors (as numbered in Figure 4.II)

*1. unimportant   2. fairly important 3. important   4. absolutely essential

———— mean level of question 1 per location factor.

━━━━ mean level of question 2 per location factor.

maximum number of cases 14.

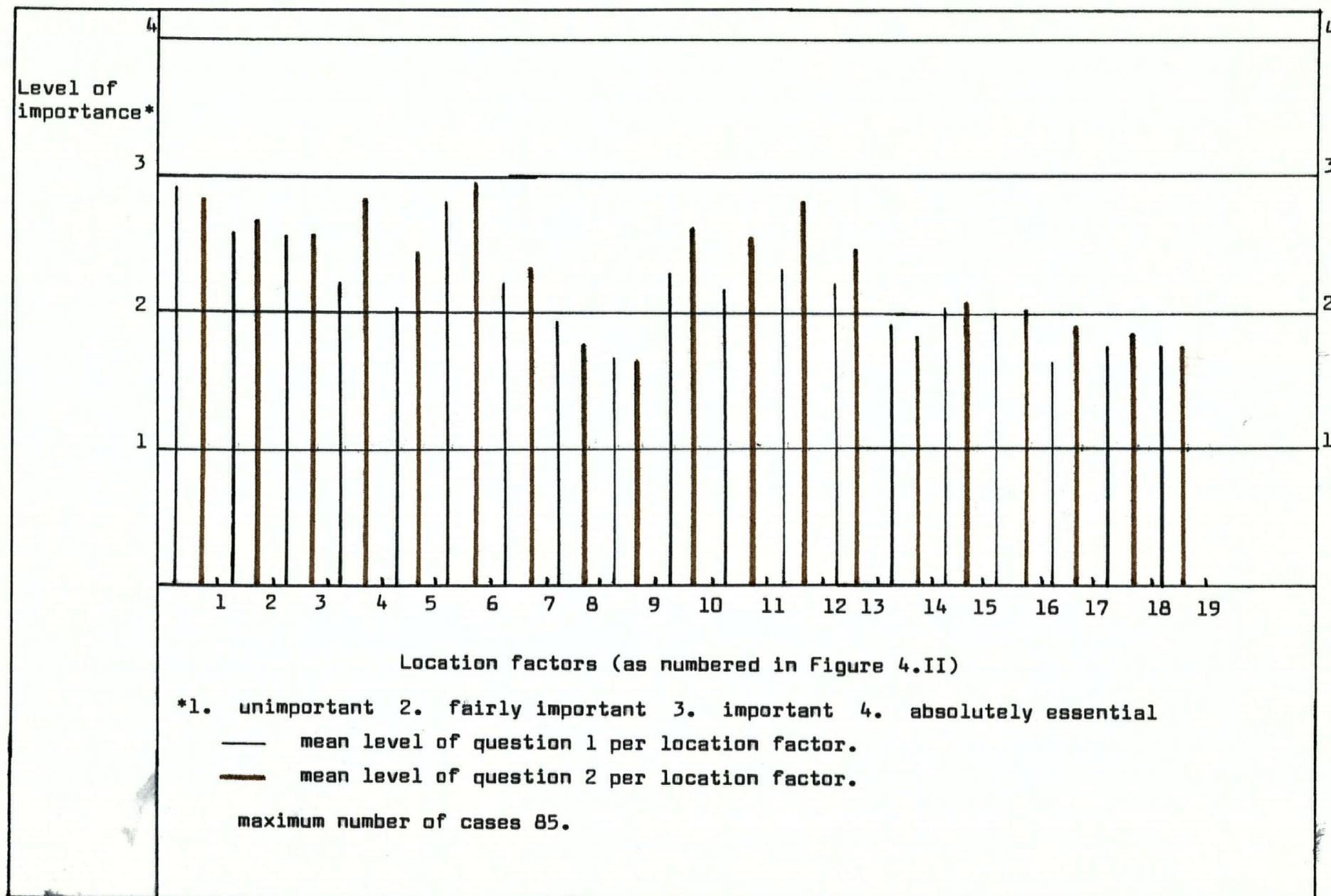Figure II. Manufacturing Sectors. Mean responses to questions 1 and 2 of the location survey questionnaire.

Location factors (as numbered in Figure 4.II)

*1. unimportant 2. fairly important 3. important 4. absolutely essential

——— mean level of question 1 per location factor.

▬▬▬ mean level of question 2 per location factor.

maximum number of cases 85.

Figure III. Retail Trade: Mean responses to questions 1 and 2 of the location survey questionnaire.

Level of importance*

Location factors (as numbered in Figure 4.II)

*1. unimportant 2. fairly important 3. important 4. absolutely essential

——— mean level of question 1 per location factor.

━━━ mean level of question 2 per location factor.

maximum number of cases 28.
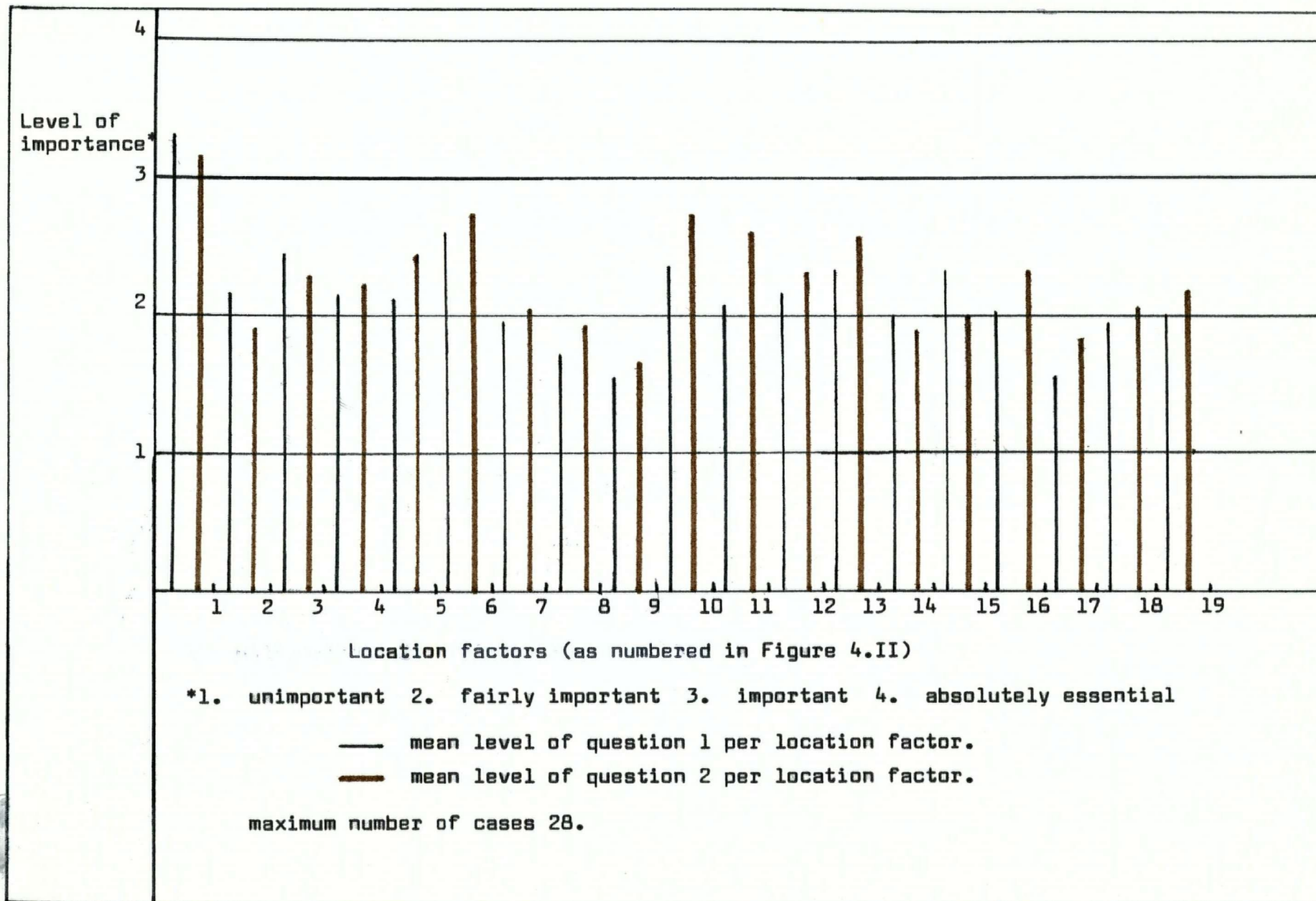
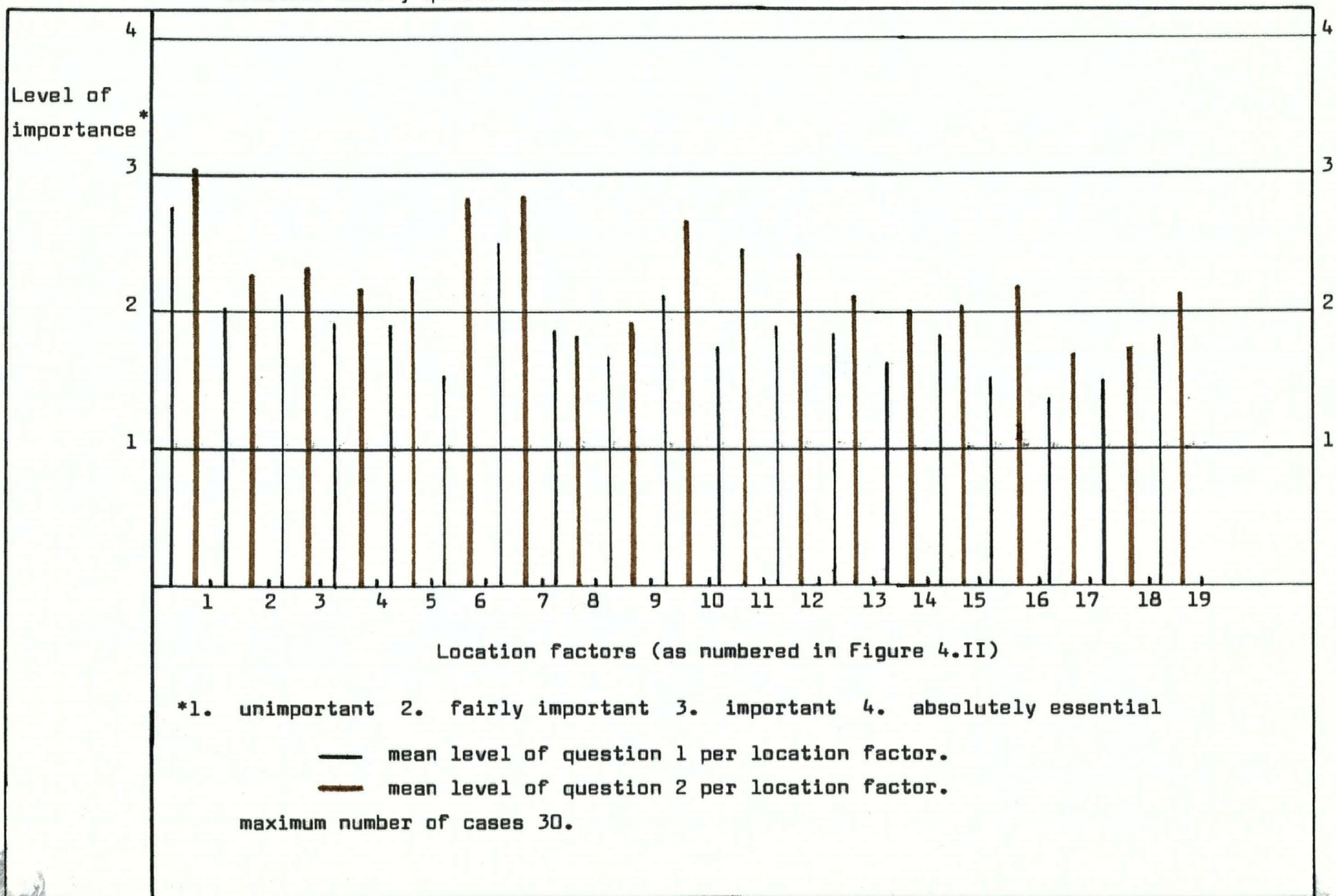Figure IV. Wholesale trade and storage: Mean responses to questions 1 and 2 of the location survey questionnaire.

Location factors (as numbered in Figure 4.II)

*1. unimportant 2. fairly important 3. important 4. absolutely essential

——— mean level of question 1 per location factor.

⬤⬤⬤⬤ mean level of question 2 per location factor.

maximum number of cases 30.

Figure V. Infrastructure: Mean responses to questions 1 and 2 of the location survey questionnaire.

Level of importance *

Location factors (as numbered in Figure 4.II)

*1. unimportant 2. fairly important 3. important 4. absolutely essential

—— mean level of question 1 per location factor.

▬▬ mean level of question 2 per location factor.

maximum number of cases 12.
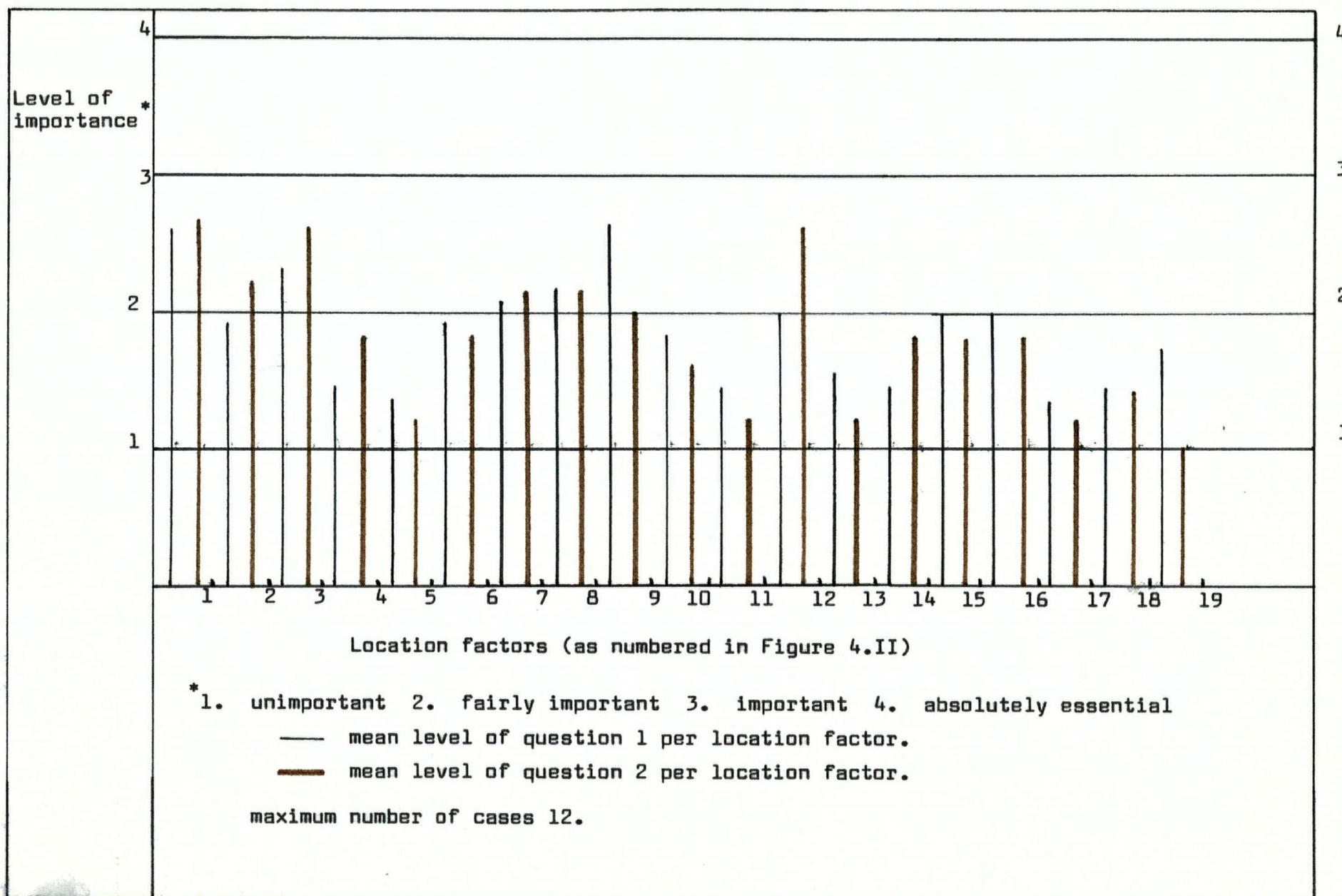
Figure VI. Financial and administrative services: Mean responses to questions 1 and 2 of the location survey questionnaire
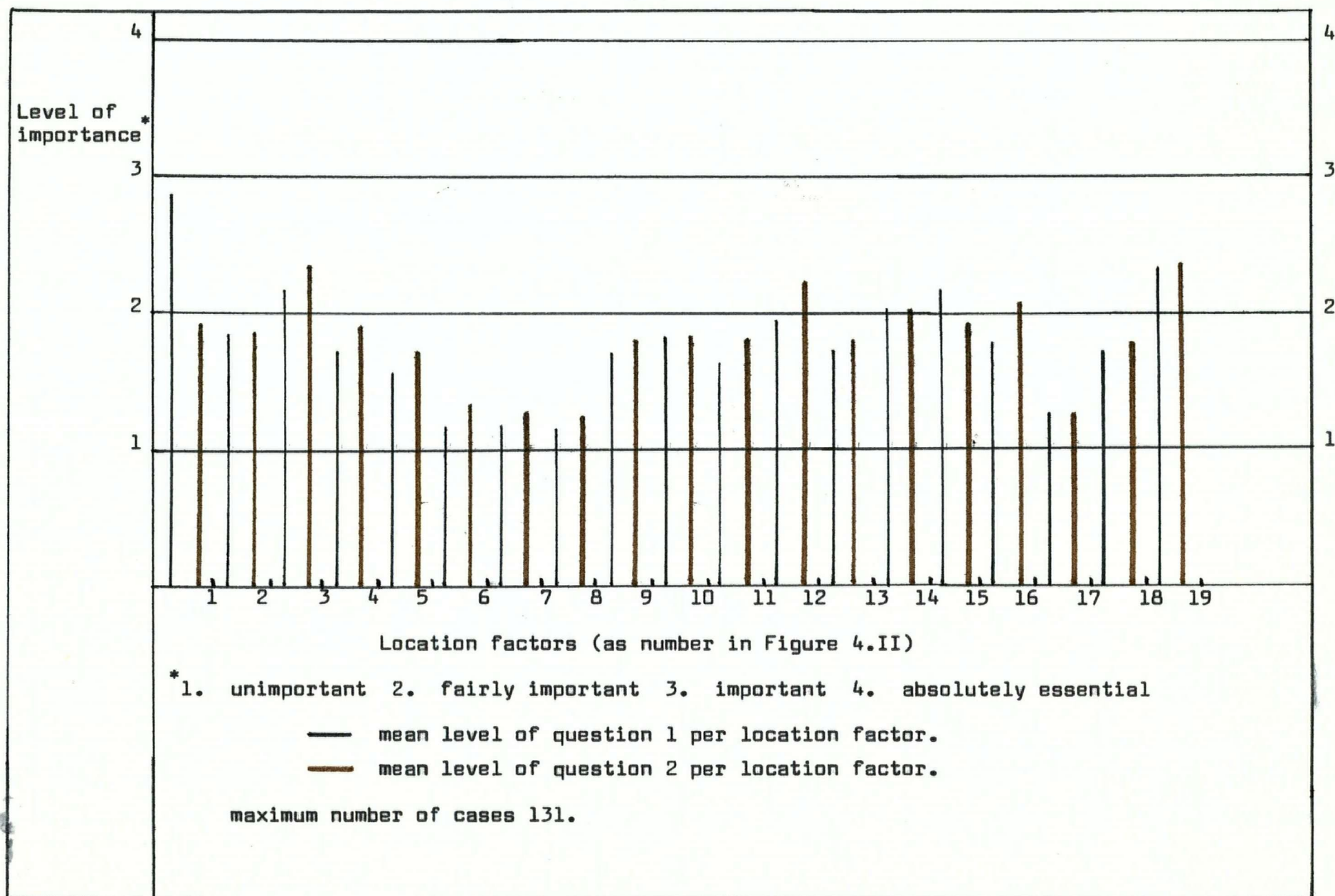
Level of importance *

Location factors (as number in Figure 4.II)

*1. unimportant 2. fairly important 3. important 4. absolutely essential

——— mean level of question 1 per location factor.

——— mean level of question 2 per location factor.

maximum number of cases 131.

Figure VII. All Sectors: Mean responses to questions 1 and 2 of the location survey questionnaire.

*1. unimportant 2. fairly important 3. important 4. absolutely essential

——— mean level of question 1 per location factor.

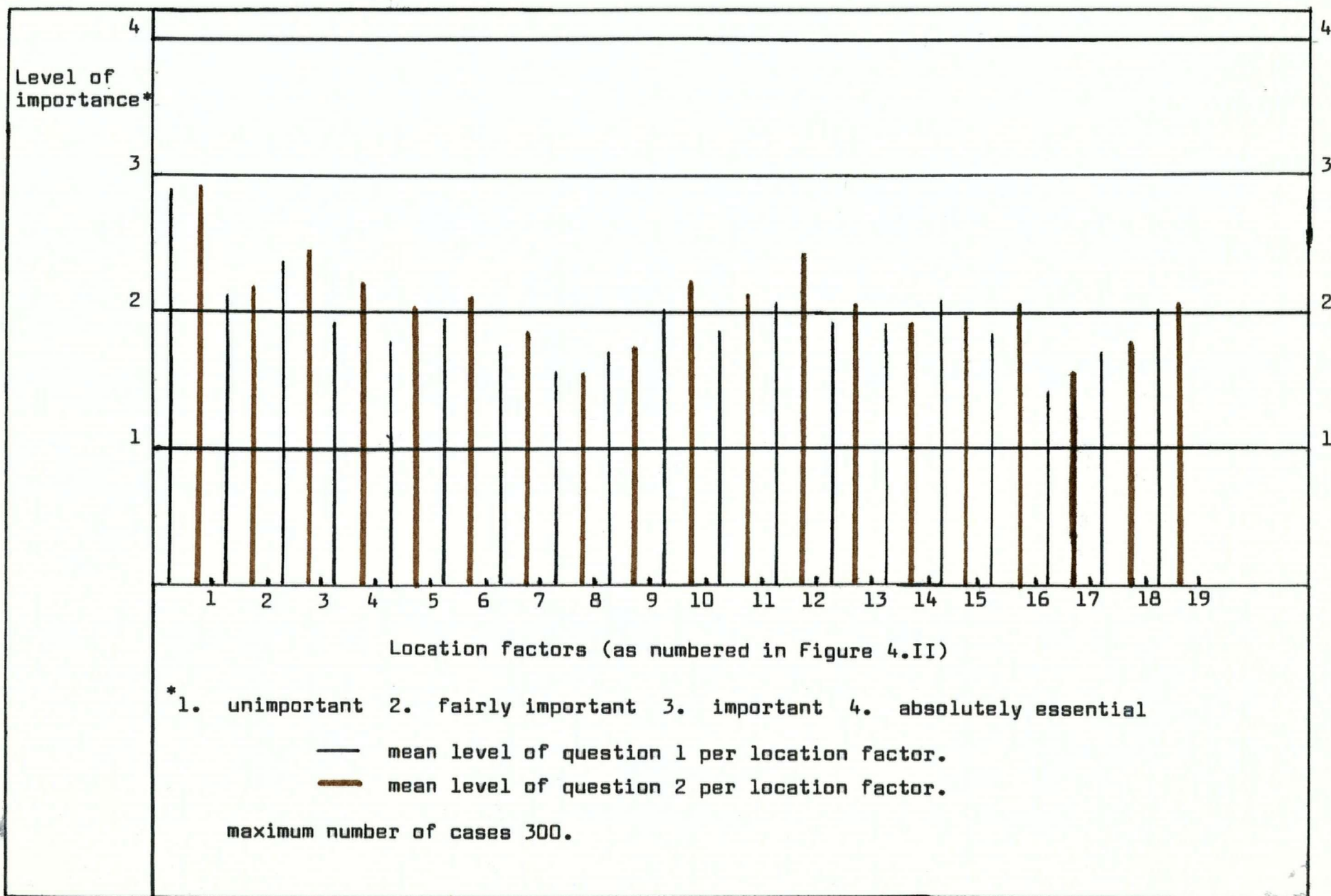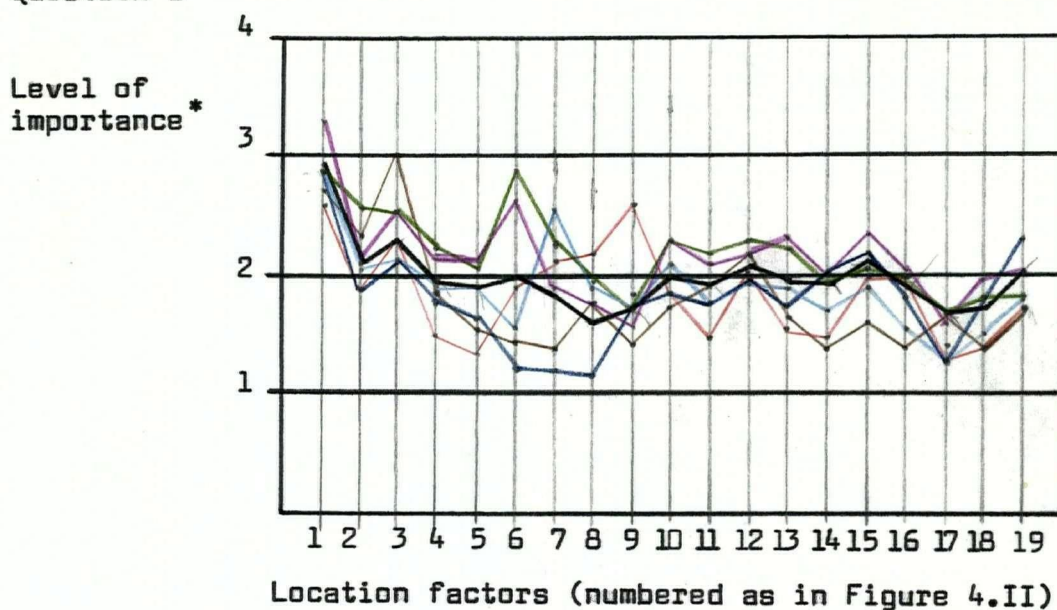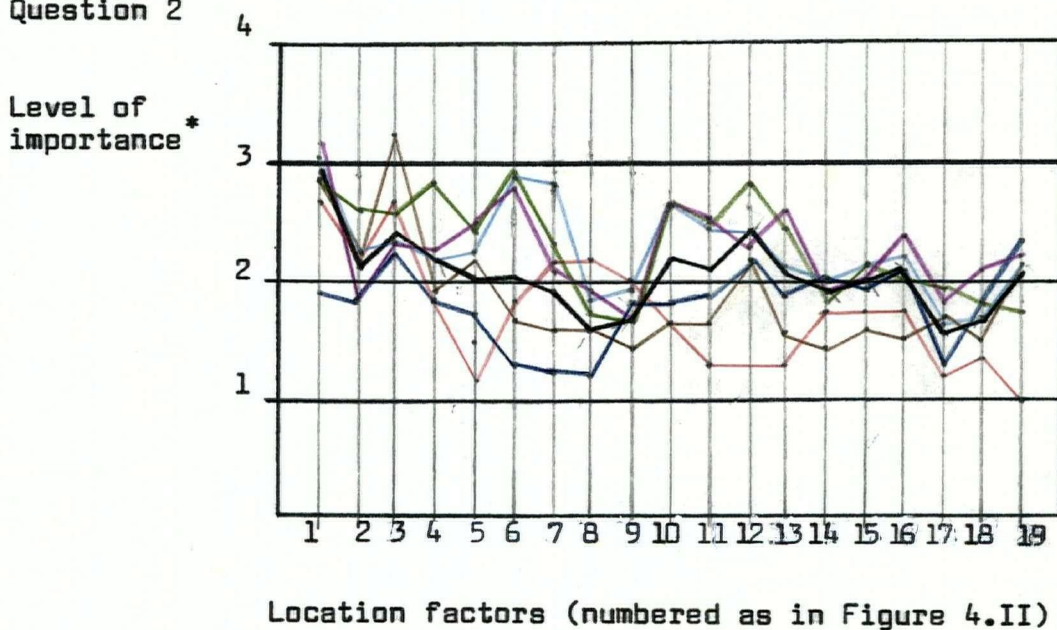▬▬▬ mean level of question 2 per location factor.

maximum number of cases 300.

216

Figure VIII. Mean Responses on Questions 1 and 2 of the Location Survey Questionnaire by Subpopulation

Question 1

Level of importance*

Location factors (numbered as in Figure 4.II)

Question 2

Level of importance*

Location factors (numbered as in Figure 4.II)

*1. unimportant; 2. fairly important; 3. important; 4. absolutely essential.

primary sectors
manufacturing sectors
retail trade
wholesale trade and storage
infrastructure
financial and administrative services
all sectors

APPENDIX IV

Statistics Used Directly in the Study

1. The Arithmetic Mean

Nie, Bent and Hull state that:

"The arithmetic mean is defined as the fum of the scores of a variable divided by the total number of valid cases for that variable. The formula for the arithmetic mean $\bar{X}$ is

$$\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N}$$

where X_i equals the score of each case, and where N represents the total number of valid cases. When the data is given in grouped form, which is a common practice when a large number of cases is involved, it is conventionally assumed for the purpose of computing the mean that the values within each category are concentrated at the mid-point of their respective interval rather than evenly distributed throughout it. The formula for computing the mean when grouped data is involved then becomes

$$\bar{X} = \frac{\sum_{i=1}^{k} f_i m_i}{N}$$

where f_i equals the number of cases in the ith category, m_i equals the midpoint of the ith category, and k equals the number of categories involved. In this case

$$N = \sum_{i=1}^{k} f_i$$

2. The Standard Deviation and Variance

Standard deviation is the square root of the arithmetic mean of the squared deviations from the mean. In other words, the deviations of the scores from the mean are determined, each deviation is squared and the arithmetic mean of these number is calculated, then the square root of that mean is taken. The formula for the standard

deviations is

$$s = \left[\frac{\sum_{i=1}^{N} (X_i - \bar{X})^2}{N} \right]^{1/2}$$

where $\bar{X}$ equals the mean of the original scores. Several other formulas can be used when computing from ungrouped data. Two of these are

$$s = \left[\frac{\sum_{i=1}^{N} X_i^2 - \frac{(\sum_{i=1}^{N} X_i)^2}{N}}{N} \right]^{1/2}$$

When computing from grouped data, it is assumed that each case within a given interval i is located at the midpoint d_i of that interval. If x_i is set equal to $d_i - \bar{X}$, x_i represents the deviation of the midpoint from the mean. The general formula then becomes

$$s = \left[\frac{\sum_{i=1}^{N} f_i x_i^2}{N} \right]^{1/2}$$

Variance is equal to the square of standard deviation. Its formula therefore becomes

$$\text{Variance} = s^2 = \frac{\sum_{i=1}^{N} (X_i - \bar{X})^2}{N}$$

and its computing formulas are found by simply removing the square-root sign from any of the computing formulas for standard deviation.

3. Chi-Square

The Chi-square statistic given in the table of FASTABS subprogram is based upon Pearson's Chi-square test of association. It tests the independence (or lack of statistical association) between two variables. It does not measure the degree of association; it only indicated the likelihood of having a distribution as different from statistical independence by chance alone as the observed distribution. Its formula is

$$\chi^2 = \sum_i \frac{(f_o^i - f_e^i)^2}{f_e^i}$$

with $(r - 1)(c - 1)$ degrees of freedom, where f_o^i equals the observed frequency in each cell, f_e^i equals the expected frequency, c equals the number of columns in the table, and r equals the number of rows in the table. The expected frequency f_e^i is calculated as

$$f_e^i = \left(\frac{c_i r_i}{N}\right)$$

where c_i is the frequency in a respective column marginal, r_i is the frequency in a respective row marginal, and N stands for total number of valid cases.

The probability figure given in the table indicates on what level the difference between the observed distribution and the expected distribution can be thought as significant. It shows the probability of having as much difference between the sample distribution and the expected distribution if in fact the population distribution were independent.

For example, if the probability associated with given value of X^2 is .os, one can reject the null hypothesis that the two variables are independent at the significance level of .05 or greater.

Chi-square gives the most accurate result when applied to tables with a large value of N, as chi-square distribution tables are based on large sampling. Therefore, when the expected frequencies in some cells of the table run as low as 5, it is a good idea to make some correction for continuity, as the possibilities of different values for chi-square are rather limited when the cell frequencies are small integers. The correction which will tend to make the value for chi-square somewhat smaller, consists of bringing all observed frequencies closer to the values of the expected frequencies by either adding or subtracting 0.5 in each cell before computing chi-square.

Another way of getting around the problem of small frequencies is combining two or more categories. If most cell values are fairly large and only a few are as small as 5, it is not really necessary to make any adjustment at all before computing chi-square.

4. Fisher's Exact Test

Fisher's exact test is used with 2 x 2 contingency tables to yield exact, rather than approximate, probabilities. It is most useful for small samples. Its formula is

$$P_i = \frac{R_1!R_2!C_1!C_2!}{N!a!b!c!d!}$$

where R_1 equals the frequency total for row 1, R_2 equals the total for row 2, C_1 equals the total for column 1, C_2 equals the total for column 2; a, b, c, and d are all the frequencies of cells a, b, c, and d, respectively (assuming that the cells are lettered as in the accompanying diagram).

a	b	R_1
c	d	R_2

C_1 C_2

If one finds the probability of the observed distribution, as well as every other possible distribution giving as much or more evidence of association, then one can test the hypothesis that the given distribution is purely a product of chance by taking the calculated sum of P_i values (or probability) as the significance level. Fisher's exact test is essentially one tailed.

The value of the exact significance level (or probability) is calculated by computing P_i for the given table and also for each possible table with a variation on the distribution that is more

extreme than that of the given table and then adding up all the values of P_i.

5. Kendall's Tau B and Tau C

Kendall's tau b and tau c both depend upon rank order, but tau c is intended for tables with an unequal number of rows and columns. The value of tau b can vary from -1 to +1, depending on how much agreement exists between the ranks of the rows.

In calculating tau b and tau c, count all possible number of pairs, $(½)N(N - 1)$, than partition these into the following three groups:

P = all pairs in which the order on one variable is the same as the order on the other - concordant pairs

Q = all pairs in which the order on one variable is the opposite of the order on the other - discordant pairs

T = all pairs in which at least one variable shows a tie

Then

$$\text{Tau b} = \frac{P - Q}{1/2N(N - 1)}$$

Tau b can be computed with adjustment for ties by the use of the formula

$$\text{Tau b} = \frac{P}{1/2N(N - 1) - T_1} \quad \frac{Q}{1/2N(N - 1) - T_2}$$

where T_1 equals the number of ties in the first variable, and T_2 equals the number of ties in the second variable. Tau c has the formula

$$\text{Tau c} = \frac{2m(P - Q)}{N^2(m - 1)}$$

where m represents either the number of rows or the number of columns in the table, whichever is smaller.

Source: Nie, N. H., Bent, D.H., and Hull, C.H., Statistical Package for the Social Sciences (New York: McGraw-Hill Book Company, 1970) pp. 272-275, 277.

6. Spearman Rank-Order Correlation Coefficient

Spearman's rank correlation coefficient is defined by:

$$rs = 1 - \frac{6 \sum_{i=1}^{N} d_i^2}{N^3 - N}$$

where: d_i = rank differential for the ith pair of observations

n = number of pairs of observations.

Source: Hornett, D.L., _Introduction to Statistical Methods_, (London: Addison Wesley Publishing Co., 1970).

APPENDIX V

THE DATA

The source of the data utilized in this study was a location questionnaire survey conducted by the VMIS in the Fall of 1972. 3600 firms in the G.V.R.D. were contacted. A copy of the data on computer cards and relevant computer output is provided to the Urban Land Economics Department in the Faculty of Commerce and Business Administration.

The study consists of 300 usable respondents, coded as follows:

Each questionnaire is defined over an 80 column field with format:

(F6.0, 1X, F3.0, 1X, F4.1, F4.0, 1X, F2.0, 38F1.0, 9X, F5.2, 6X)

Columns 1 - 6:   Identification Number. This refers to the particular firm which made the response.

Column 7:   Blank

Columns 8 - 10:   SIC Number

Column 11:   Blank

Columns 12 - 15:   Sector. This refers to the economic sector as coded in the VMIS.

Columns 16 - 19:   Number of Employees

Column 20:   Blank

Column 21 - 22:   Location Code. Please refer to Figure 5.I.

Columns 23-60:   Questionnaire Variables. V006 to V043

Columns 61 - 69: Blank

Columns 70 - 74:   Undefined Variable. This refers to a variable which was keypunched but subsequently considered to be extraneous.

Columns 75 - 80: Blank.