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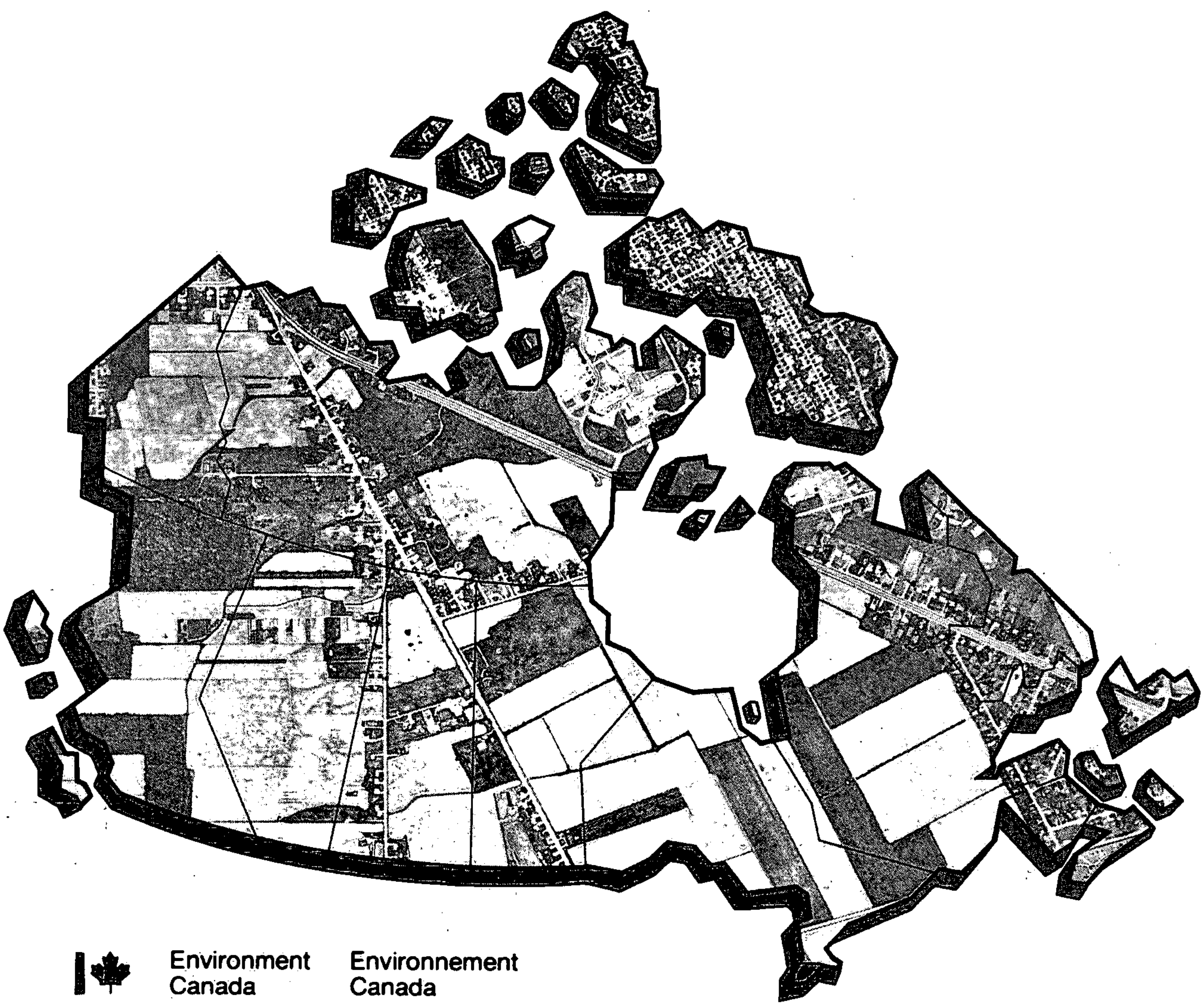
URBAN GROWTH, INFRASTRUCTURE, AND LAND CAPABILITY:

A WINDSOR EXAMPLE



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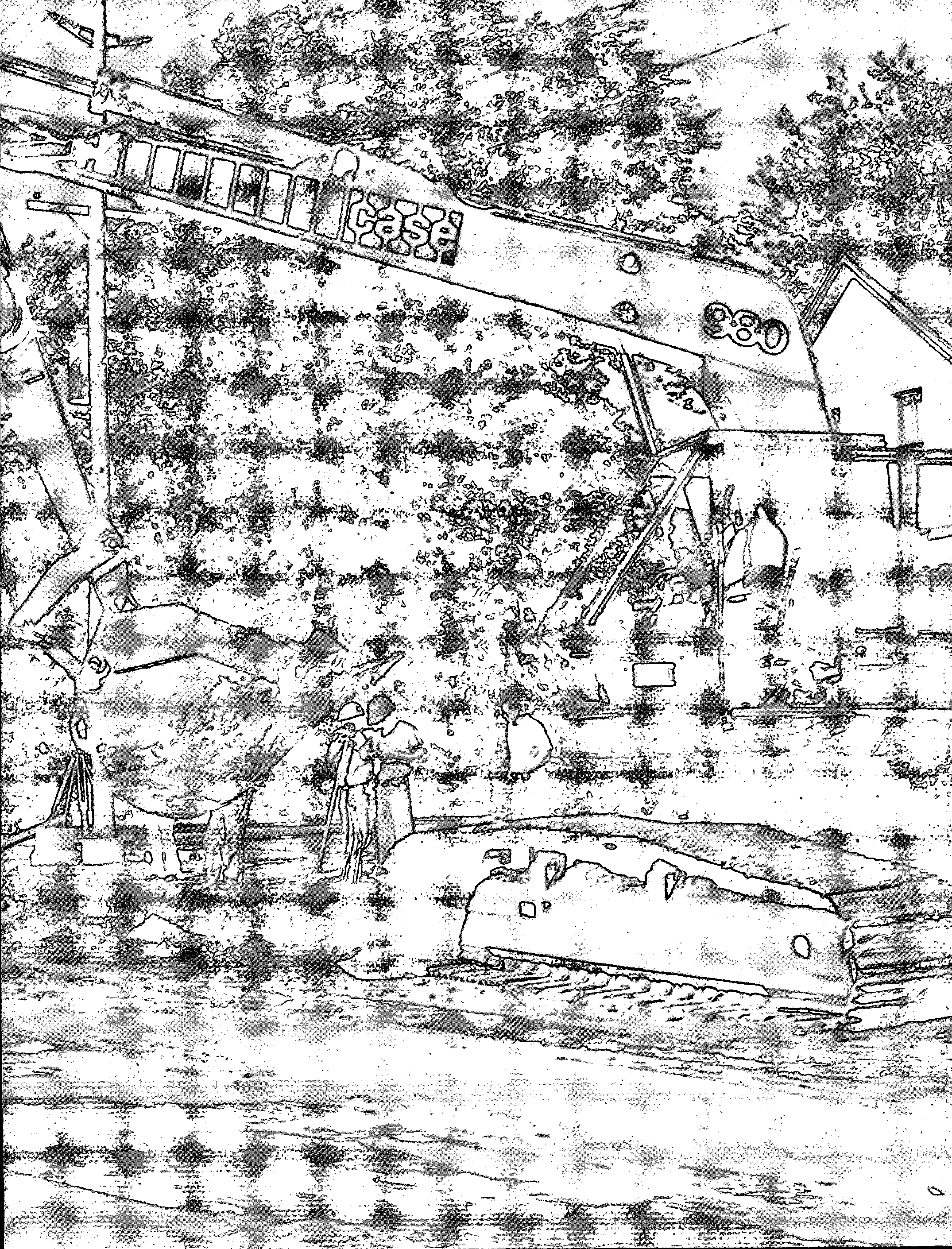
Land is a fundamental, but frequently overlooked, resource. Only where the supply of a particular quality of land is restricted, is the significance of wise use of the land recognized and appreciated. Because today's use of the land reflects yesterday's planning it is important to consider land capability in the future development of land. Land-use conflicts and allocation problems are seldom amended by hindsight, but can be tempered by foresight.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URBAN GROWTH, INFRASTRUCTURE, AND LAND CAPABILITY:

A WINDSOR EXAMPLE

by

V. Neimanis
R. McKechnie

Lands Directorate
Environment Canada

Ottawa
December 1980

LAND USE IN CANADA SERIES

The *Land Use In Canada Series* is designed to address major land-use issues and problems in Canada. The series, produced by and for the Lands Directorate of Environment Canada, examines the causes and consequences of major land problems and land-use trends throughout Canada and the role of various government programs in eliciting solutions.

Incorporating the earlier series entitled *Land Use Programs in Canada* which reviewed the land-use programs of Canada's ten provinces, the series examines, from a national perspective, activities affecting the use of Canada's land.

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PREFACE

One of Canada's fundamental issues of national concern is the use and proper management of Canada's land resource. Geographically, this concern is concentrated near urban areas, where numerous land uses are in competition for a limited supply of land. Urban areas are growing, spreading outwards onto the surrounding land area. The quantity of land being consumed for urban uses is not the only concern. Most of Canada's cities are located within the midst of the nation's best agricultural land, thus the conflict between rural and urban uses is not only intense but very serious. Both the quantity and the quality of the land being consumed for urban uses is important. To minimize the loss of prime agricultural land, a methodology is required to identify and quantify land-development options around cities. The options to preserve the higher-capability agricultural lands and yet accommodate residential development are examined for one urban area, Windsor, Ontario. Windsor's location in the heartland of some of the nation's best agricultural land constitutes an excellent as well as difficult situation on which to test the methodology developed.

The Lands Directorate of Environment Canada is engaged in a continuing program of research into the causes and consequences of land problems and issues in Canada and the means by which they can be resolved. Hopefully, through a better understanding of the demands for land, measures can be designed to influence its uses so that all Canadians will benefit from the wise use of their land resource.

R.J. McCormack
Director General
Lands Directorate

ACKNOWLEDGEMENTS

The authors wish to thank those individuals whose patience and assistance contributed to the final completion of this study. We wish to thank the Canada Land Data System Division, and in particular Rick Smale, for processing the data into an operational graphics version, thereby making this whole study possible. Peter Spurr and Brian Goselin of Canada Mortgage and Housing Corporation were both sources of encouragement and explanation of their data base which they permitted us to use. Jane T. Buckley was responsible for editing the manuscript and her expertise was greatly appreciated. The Environmental Conservation Service's Drafting Division was responsible for producing the maps and figures used to complement the text. Finally, special thanks to Carole Aubin for her perseverance in providing the typing services.

TABLE OF CONTENTS

Page

CHAPTER 1 INTRODUCTION 1

CHAPTER 2 STUDY DEFINITION 5
- Study Objectives 7
- Study Selection 7
- Land and Infrastructure Mapping Program 7
- Canada Land Inventory 8
- Outline of the Study Area 9
- Data Overview 9

CHAPTER 3 OPTIMAL USE OF THE LAND RESOURCE 13
- Agricultural Capability 15
- Constructing the Optimal Development Model 16
- Optimal Development Model 18

CHAPTER 4 ACTUAL DEVELOPMENT 23
- The Sequence of Analysis 25
- The Analysis 26
  - Lands with Sewers on or Close to Site 28
  - Lands with Sewers on or Close and Subdivision Plans Approved 28
  - Lands with Sewers on or Close and Subdivision Plans Submitted 28
  - Lands with Sewers on or Close and Subdivision Plans Approved or Submitted 30
  - Lands with Sewers on or Close and No Subdivision Plans 30
  - Lands with Sewers Planned 30
  - Lands with Sewers Planned and Subdivision Plans Submitted or No Subdivision Plans 30
  - Lands without Sewers 33
- Summary 33

CHAPTER 5 THE AGRICULTURAL CAPABILITY OF THE LANDS IN THE ACTUAL STAGES OF DEVELOPMENT 37
- Current Development 39
  - Subdivision Plan Status 41
- Contiguity Factor 41
- Changes in Land-Use Activities 41
  - Within the Built-Up Area 41
  - Land Classified as Cropland 44
- Planning Options 44
- Proposed Development 44
  - Subdivision Plan Status 47
  - Pending Changes in Land-Use Activities 47
- Held for Development 51
  - Subdivision Plan Status 51
  - Possible Repercussions on Land-Use Activities 51

CHAPTER 6 CHOICES IN PERSPECTIVE: TOWARDS A STRATEGY FOR DEVELOPMENT 55
Elimination of Land-Use Variables 57
Elimination of Agricultural Subclass Variables 57
Development Stages in Relation to the Optimal Development Model 59
Current Development in Relation to Optimal Development Model 59
Proposed Development in Relation to Optimal Development Model 59
Lands Held for Development in Relation to Optimal Development Model 63
Priorities for Land Development 63

CHAPTER 7 CONCLUSION 69

POSTSCRIPT 74

FOOTNOTES 75

REFERENCES 76

APPENDICES 77
Appendix I: The Canada Land Data System 77
Appendix II: Agricultural Land Capability Classification System 79
Appendix III: Present Land Use 1972 Index Description 80
Appendix IV: Definitions of Land Supply Characteristics 81

TABLES

Page

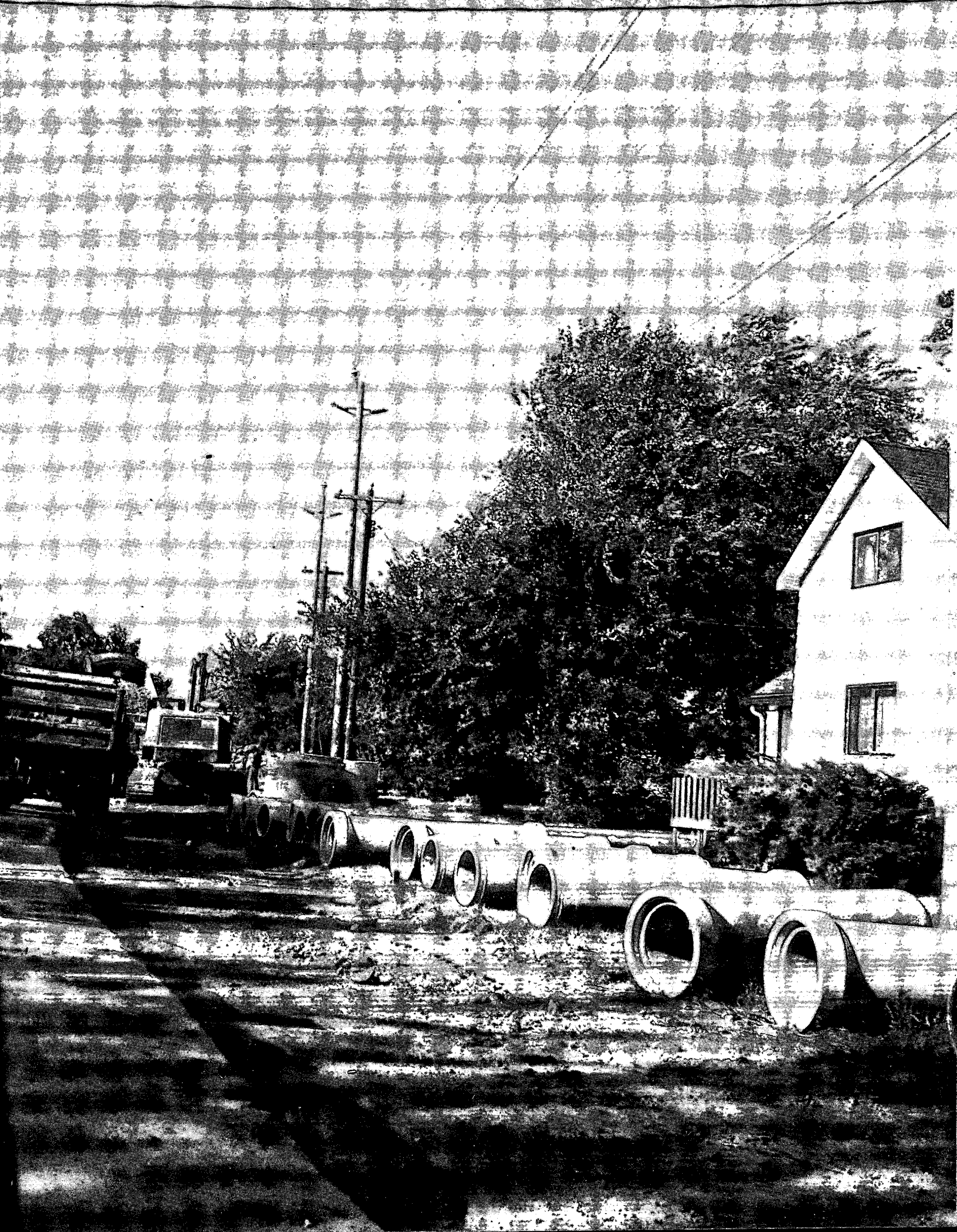
1. Agricultural Land Capability by Sector 16
2. Agricultural Capability of Lands Suitable for Urban Development 18
3. Lands of Lowest Agricultural Capability Suitable for Development Excluding Selected Land Uses 19
4. Lands of Moderate and Lowest Agricultural Capability Suitable for Development Excluding Selected Land Uses 19
5. Optimal Development Model: Combining Lands of Low, Moderate, and High Agricultural Capability Suitable for Development Excluding Selected Land Uses 21
6. Sewer Characteristics and Subdivision Plan Status for Developable Lands by Sector 35
7. The Developable Land Supply in Relation to the Optimal Development Pattern 59

MAPS

		Page
1.	Windsor Study Area	10
2.	Sector Boundaries of the Windsor Study Area	12
3.	Optimal Development Model: Combining Lands of Low, Moderate, and High Agricultural Capability Suitable for Development Excluding Selected Land Uses	20
4.	Private Developable and Public Developable Lands	27
5.	Sewered Lands Approved for Subdivision	29
6.	Sewered Lands with Subdivision Plans Approved and Submitted	31
7.	Lands with Sewers Planned	32
8.	Lands without Sewers	34
9.	Current Development Using Lands within the Urban Built-Up Area	45
10.	Appropriate Areas for Proposed Development	49
11.	Inappropriate Areas for Proposed Development	50
12.	Developable Land Holdings which coincide with the Optimal Development Pattern Removing Land-Use Restrictions	58
13.	Developable Land Holdings which coincide with the Optimal Model Removing Agricultural Subclass Restrictions	60
14.	The Current Development Pattern which coincides with the Optimal Development Pattern	61
15.	Lands Proposed for Development which coincide with the Optimal Development Pattern	62
16.	Proposed Development Inappropriately Channelled onto High-Quality Cropland	64
17.	Lands Held for Development which coincide with the Optimal Development Pattern	65
18.	High-Quality Agricultural Lands Held for Development	66
19.	Lower-Quality Agricultural Lands Held for Development	68

FIGURES

		Page
1.	General Approach	4
2.	Current Development of lands with Sewers and Their Agricultural Land Capability	40
3.	Current Development, Its Agricultural Land Capability, and Subdivision Plan Status	42
4.	Land Uses Now Undergoing Current Development	43
5.	Proposed Development, Its Agricultural Land Capability, and Subdivision Plan Status	46
6.	Proposed Development and the Land Use Activities it Affects	48
7.	Land Held for Development, Its Agricultural Land Capability, and Subdivision Plan Status	52
8.	Land Held for Development and the Affected Land Uses	53



INTRODUCTION

Each year, Canadian urban areas[1] cumulatively consume a land area equal in size to Hamilton, Ontario (Gierman and Lenning, 1980). Not only is the quantity of land consumed of serious concern, but more importantly the irreplaceable quality of that land. Of those lands converted, 63 percent were of high agricultural capability.[2] In fact, most Canadian cities are surrounded by such high-capability agricultural lands (Neimanis, 1979). If the process of land conversion continues unchecked, a significant amount of prime agricultural land will be permanently lost. Only five percent of Canada's total land area is classified as high-capability agricultural land, and continued loss of such land has serious national as well as local repercussions.

"Canada's vast size and her position as the second largest wheat exporter are well known. There is also general awareness that our farms are large and highly mechanized. I think such knowledge causes grave misunderstandings, both at home and abroad, about Canada's potential to increase food production at costs which consumers will be able to pay without increases in the proportion of disposable incomes spent on food.

There is, on a world basis as well as in Canada, a great deal of over-estimation regarding the amount, quality and productive potential of Canada's agricultural land resources. Those overestimates contribute to the continuing removal of significant amounts of good quality agricultural lands from agricultural production.

. . . loss of prime agricultural land, and its replacement for food production by areas of lower land quality, will tend to increase costs of production. Food costs will tend to rise at home and potential purchasers of Canadian agricultural exports will be less able to purchase our high-priced products." (Bentley, 1978)

This paper contends that by planning the location of sewers in conjunction with land's natural capability, city growth can be accommodated, yet effectively directed away from prime agricultural lands. The growth options are explored for one city — Windsor, Ontario. The methodology developed for using land capability as a planning tool is not restricted to this particular case study.

By their very nature, North American urban centres require a large, structured, and serviced environment to support the population concentration. Investments in infrastructure are important influences in directing urban growth patterns. Such investments affect the costs and placement of new construction and have a direct impact on land use. The existence of infrastructure investments such as sewers, on yet-to-be-developed land indicates that growth is planned for that specific area. Such services are one of several important factors which shape the overall growth pattern of a region.

Neither developers nor infrastructure planners are concerned directly with the capability of the land consumed for urban growth. Instead, the land is viewed as a commodity for the housing market rather than as a resource. From a physical viewpoint the best lands for construction are flat, well-drained, and have adequate soil depth and soil stability. Also, the unit of land must be sufficiently large to permit serviced development. Unfortunately, these same characteristics describe lands of high agricultural capability. Because of this coincidence, an intense competition exists between agricultural and urban land uses. Urban uses place a considerably higher value on any site, thereby usually outbidding agricultural uses for the land, and therefore urban growth takes place often at the expense of high-capability agricultural land around urban centres.

Recognizing land as a resource demands the consideration of land capability as an important component in planning for urban growth. One means of accomplishing this is to plan urban growth and its associated infrastructure in response to land capability. Such actions will contribute to a wiser allocation of land resources.

This study focuses on Windsor, Ontario and identifies the infrastructure pattern and its effect on the surrounding land resource. It examines infrastructure and land capability independently, then relates the two to investigate the capability of land that is being used for urban development. The procedures adopted in this particular study are outlined in Figure 1.

An optimal development model for Windsor was constructed based on the preservation of high-capability agricultural land. This was accomplished by using lands of least agricultural capability for new residential development. To increase the applicability of the optimal model, land-use information was introduced as a second variable. Based on Windsor's annual growth requirements for land, the model was modified until a balance between land demand and supply was established. This model then formed a basis to which other land actions could be compared.

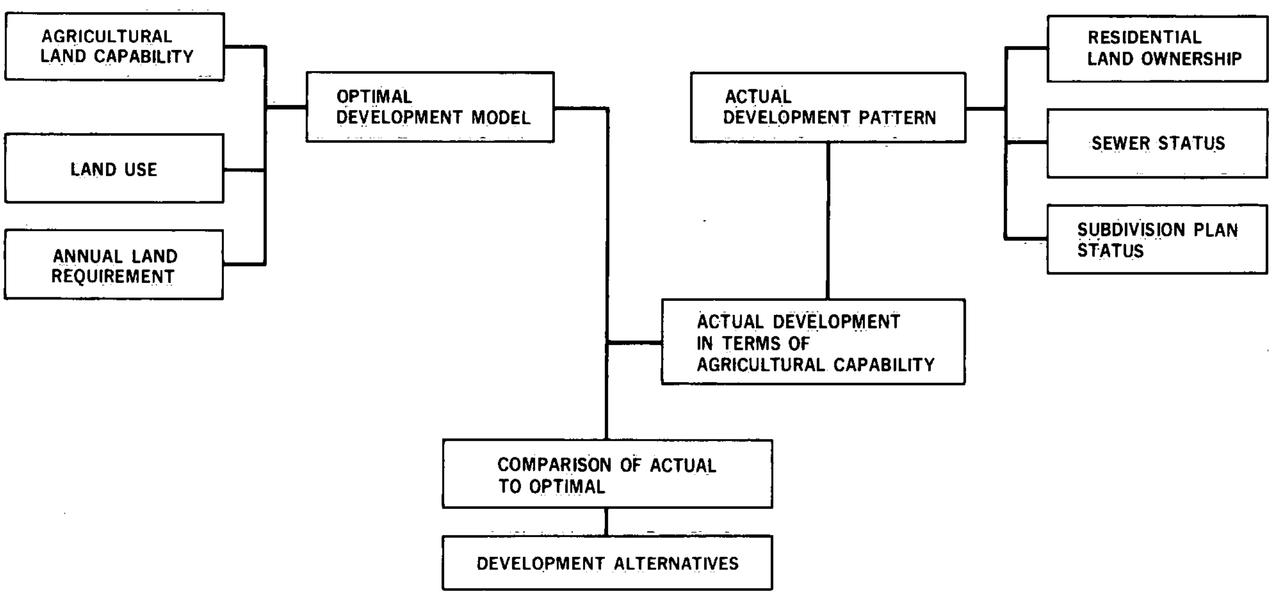
The land owners involved with residential land development were then identified to examine actual development. These land holdings were classified into three stages of development according to their sewer status: currently being developed (land is serviced); proposed for development (land is designated for servicing); and held for development (land is unserviced).

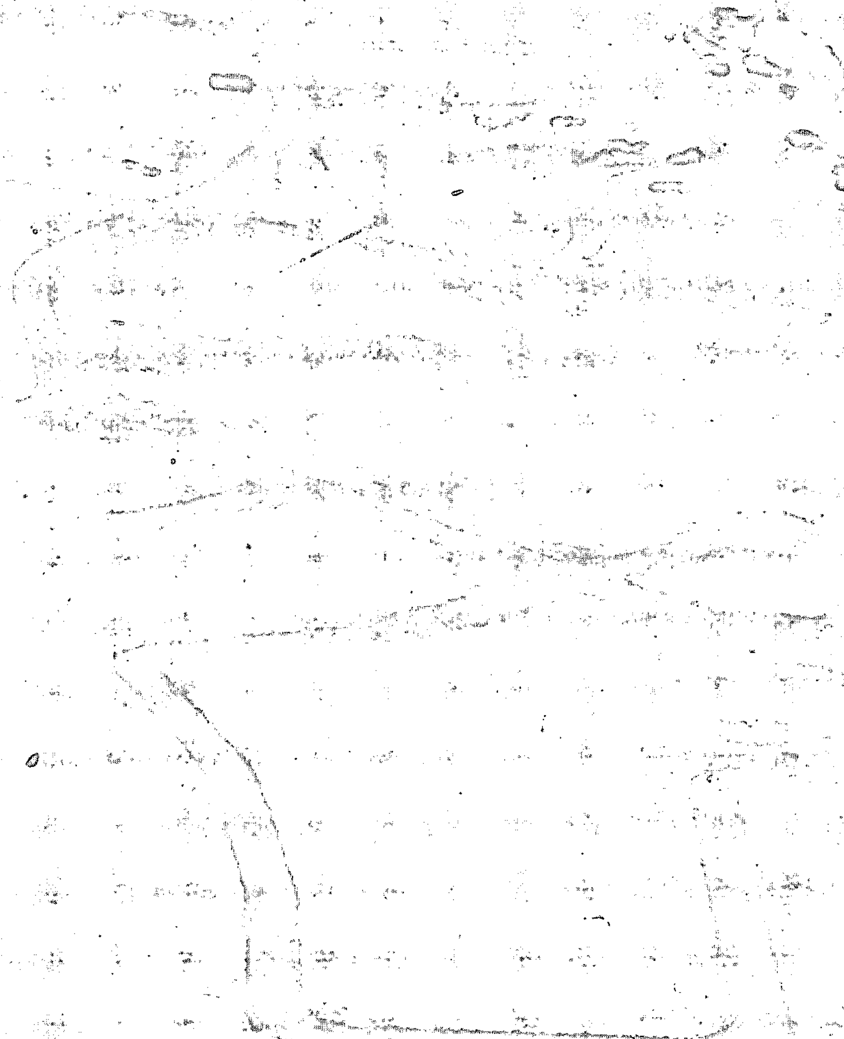
Once established, the actual development pattern was then analyzed in terms of agricultural land capability. This approach identified the agricultural capability of the lands that were involved in the three development stages.

The next step was the comparison of actual development to the optimal development model. Such a comparison showed where development was actually occurring and where development could ideally be channelled. This approach allowed an assessment of the overall growth pattern. Viable options or alternatives could then be identified which preserve high-capability agricultural lands. The flexibility of the methodology developed enables it to be applied to other Canadian cities.

Using this method, land capability can be quantified and used as an important factor in planning land use, which should interest planners, developers, and decision makers as well as those involved with land-use research. As a pilot study, this is an experiment in amalgamating two national data bases which readily allows further application to other cities in Canada. This report advocates the wise use of the land resource so as not to diminish further the supply of high-capability agricultural land around Canada's cities. The economics or fiscal questions associated with investment in the land resource are not directly included in this case study.

Figure 1. General Approach





STUDY DEFINITION

The urban area of Windsor, Ontario, was selected for this study and detailed information on the land supply and development potential of that area was obtained and analyzed. As a pilot project, data from the Land and Infrastructure Mapping Program of the Canada Mortgage and Housing Corporation[3] (CMHC) were integrated with the Canada Land Inventory data. These data bases were integrated and analyzed using the spatial data handling capabilities of the Canada Land Data System/Canada Geographic Information System operated by the Lands Directorate, Environment Canada.

Study Objectives

Three objectives were established for this study. One was to examine potential land-use change and options for growth around Canada's cities, with Windsor being the case example. The second was to examine the feasibility, and utility of incorporating CMHC's Land and Infrastructure Mapping Program into the Canada Land Data System (CLDS)/Canada Geographic Information System (CGIS) for land-use planning. The third was to develop a planning tool based on land capability and land use using the CLDS (for information on CLDS *see* Appendix I).

Study Selection

Windsor is located in southern Ontario where population pressures and competition between uses for the land resource are intense. It lies in an area of Essex County prominent for agricultural production and provides an illustration of the competition between urban and agricultural uses on areas of good-quality agricultural land. Windsor's growth has been somewhat concentrated by its site location as expansion to the north and west is constrained by water and the international boundary.

Windsor has been prone to a boom and bust economy since it has been directly linked to the automobile industry. In fact, on December 17, 1978, Toronto's Globe and Mail headlines declared "Windsor Set To Become Next Boom Town." The article stated that "In the past 12 months, Windsor has become the beneficiary of almost $1 billion in new investment, placing it on the threshold of prosperity and industrial growth." Consequently, the city's population was expected to increase by 30,000 to 40,000. However this optimism was short lived when on May 1, 1980, the Globe and Mail's headlines read, "Windsor Suffers New Blow As Chrysler drops Engine Plant Plan." Later that month (May 24, 1980) the Ottawa Journal published an article, "Windsor Bearing Brunt of Slump In Car Industry." To quote, "Shaken but not defeated this city of 200,000 is waiting for the good days to return as it bears the brunt of the worst slump in Canada's automotive industry". The decision to study the Windsor area was made during the period of optimism but now the tables have turned and the area faces decline. However, the choice of Windsor for study was not linked to its short lived future growth aspirations but to a long term perspective.

The selection of Windsor as the area of study for the pilot project was based partially on operational considerations. The selected city had to:

- —be a suitable example of, and be compatible with, both the Land and Infrastructure Mapping (LIM) data base and the Canada Land Inventory (CLI) data base;
- —be representative for the LIM Program in terms of the typical volume of data for the selected city in relation to all 27 cities inventoried;
- —be complete in terms of spatial coverage;
- —have available detailed CLI data at the scale of 1:50,000 already stored on the CGIS; and
- —have areas of growth recorded by LIM with a land-capability classification recorded in the CLI, and such growth had to have occurred in areas classified as other than built up by the CLI.

Based on these considerations, Windsor was chosen as a suitable urban centre for this land-resource study.

Land and Infrastructure Mapping Program

The Land and Infrastructure Mapping (LIM) Program was initiated in late 1974 by CMHC with the purpose of both monitoring the supply of and estimating the demand for serviced residential land in 27 urban centres across Canada. Since residential use is a major land consumer which accounts for some 50 to 60 percent of the land area of large cities, residential information contained within this program should provide a reasonable data base for an examination of growth around cities.

The program inventories those lands which possess each of the principal characteristics necessary for commencement of housing construction. Generally, all parcels of land are recorded which are in suburban areas, either adjacent to existing or proposed trunk sewers or trunk water mains, or in growth areas, or owned by known builders or land developers. Infill or vacant parcels within built-up areas are included where possible.

The land characteristics collected are related to each legal parcel of land as defined in a deed. The major characteristics which are recorded include:

(1) Availability of Water and Sewer Services: In order to be built upon, land must be in a position to be supplied with water, and to have removed those wastes generated by its inhabitants. This implies that the land be near trunk water and sewer lines, that the internal distribution/collection system can be connected to the trunk, and that the treatment plants at the ends of these lines have the capacity to treat the raw water and sewage.

(2) Adequate Drainage: In order for the land to be developed, the drainage system, either natural or man made, must be able to carry surface water from the development.

(3) Growth Area Designation: In order for the land to be built upon, it is usually part of an area in which the municipality and/or Provincial government has stated that growth may occur.

(4) Subdivision Approval: A prerequisite to land development and the subsequent construction of housing is the municipality's approval of a plan of subdivision.

The program compiles the information in tabular and map format. The map produced by the LIM program shows the limits of the urbanized area, the boundaries of the parcels of land and their subdivision approval status, municipally designated growth areas, and the zoning and routes of existing and planned infrastructure.

The LIM program's information was transformed into a computer data base. Specific information on the variables follows.

From the Land and Infrastructure Mapping Program, a data base was created with the following characteristics for each parcel:

(i) Sector location:
Sector 1 —City of Windsor
Sector 2 —Town of Tecumseh, Village of St. Clair Beach
Sector 3 —Township of Sandwich West
Sector 4 —Towns of Essex and Amherstburg, and Anderdon, Maidstone, Malden, Colchester North, and Sandwich South Townships.

(ii) Type of land ownership or land use: public developable, private developable, public undevelopable, commercial centre, parkland, industrial undeveloped, industrial developed, and existing urban area.

(iii) Parcel number.

(iv) Owner's name and a description of the land-holding location.

(v) Municipality or Township in which parcel lies.

(vi) Sewer characteristics:
(a) on site
(b) near site
(c) planned for site
(d) none.

(vii) Water characteristics:
(a) on site
(b) near site and planned for site
(c) none.

(viii) Drainage status:
(a) problem
(b) no problem.

(ix) Subdivision status:
(a) site plans approved
(b) site plans submitted
(c) none.

(x) Legal size: size of parcel as stated in legal deed in hectares.

The Canada Land Inventory

The Canada Land Inventory (CLI) is a comprehensive survey of land capability and land use designed to provide a basis for resource and land-use planning. It was undertaken as a co-operative Federal-Provincial program and began in 1963. Land capability is defined as the ability of land to support a land use at a specific level of management practice. According to its physical capability for use, land was assessed and classified into seven classes for each of the

resource sectors independently: agriculture, forestry, recreation, and wildlife. The land of highest capability for a particular use in a sector is designated as Class 1 whereas a Class 7 designation indicates very little or no capability for that resource sector. Information on land use was also collected.

In applying the CLI data set to that of the Land and Infrastructure Mapping Program, the parcel information is enlarged to include:

(i) The agricultural capability of the land, Classes 1 through 7. (*See* Appendix II).

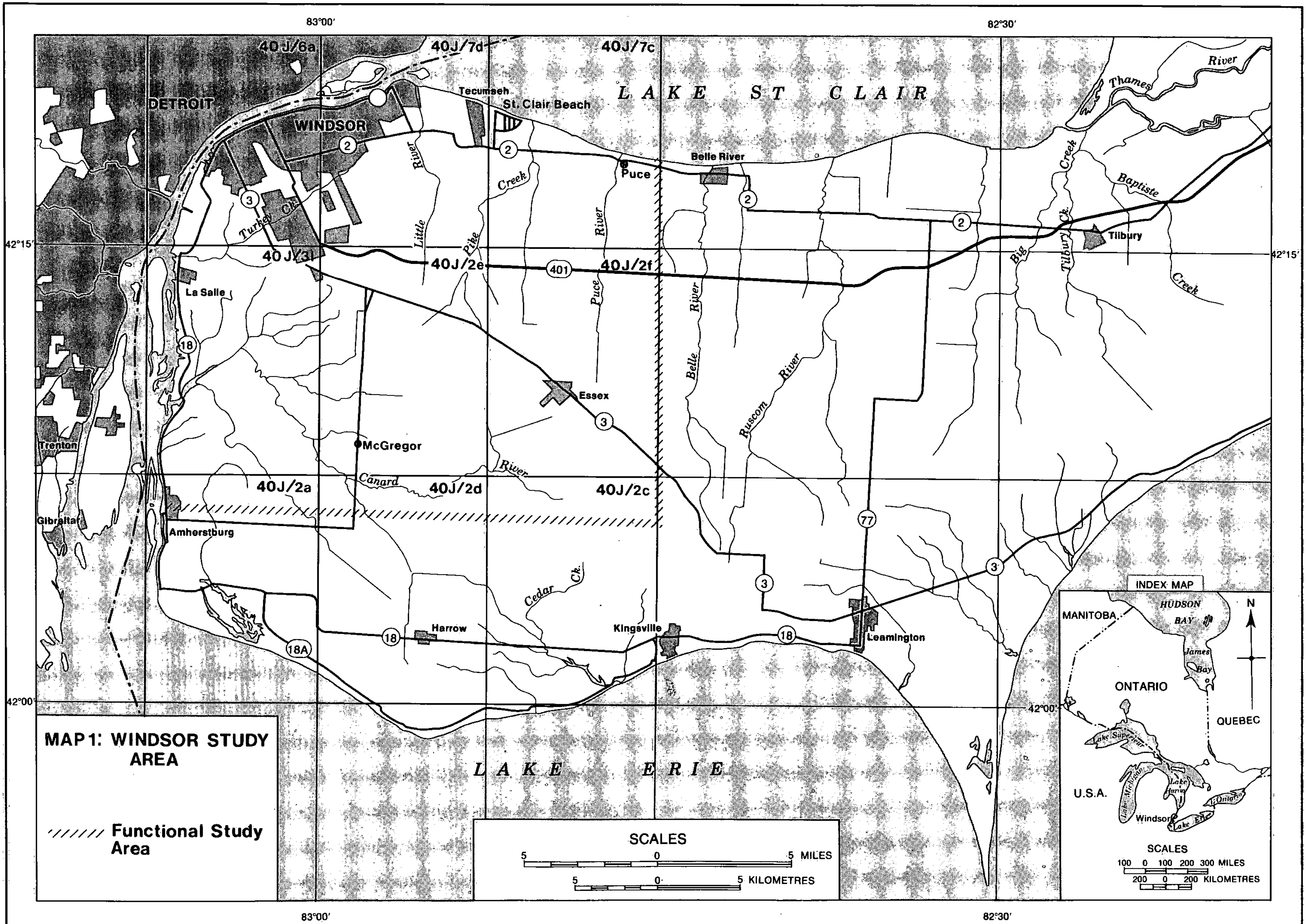
(ii) Agricultural sub-classes: adverse climate, undesirable soil structure and/or low permeability, erosion, low fertility, inundation by streams or lakes, moisture limitation, salinity, and stoniness, etc. (*See* Appendix II).

(iii) Land use (1972) for the parcels by categories of urban built-up, mines, quarries, sand or gravel pits, outdoor recreation, horticulture, orchards and vineyards, cropland, swamp, improved pasture, and forage crop, etc. (*See* Appendix III).

In this pilot study, the amalgamation of this CLI data with the LIM program information permits an examination of the pressures exerted by urban activities on the land resource.

Outline of Study Area

The total data base created for the Windsor area consisted of nine National Topographic Series maps at the scale of 1:25,000 (Map 1). It includes about half of the land area of Essex County. The study area is bounded by water on three sides; on the north, west, and south by Lake St. Clair, the Detroit River, and Lake Erie respectively. Canada Land Inventory data retrieved for the outlined area were agricultural capability and land use at the scale of 1:50,000. The data base from the Land and Infrastructure Mapping Program covered only the area north of Amherstburg. The absence of infrastructure mapping data south of Amherstburg did not pose any serious problems because the majority of infrastructure



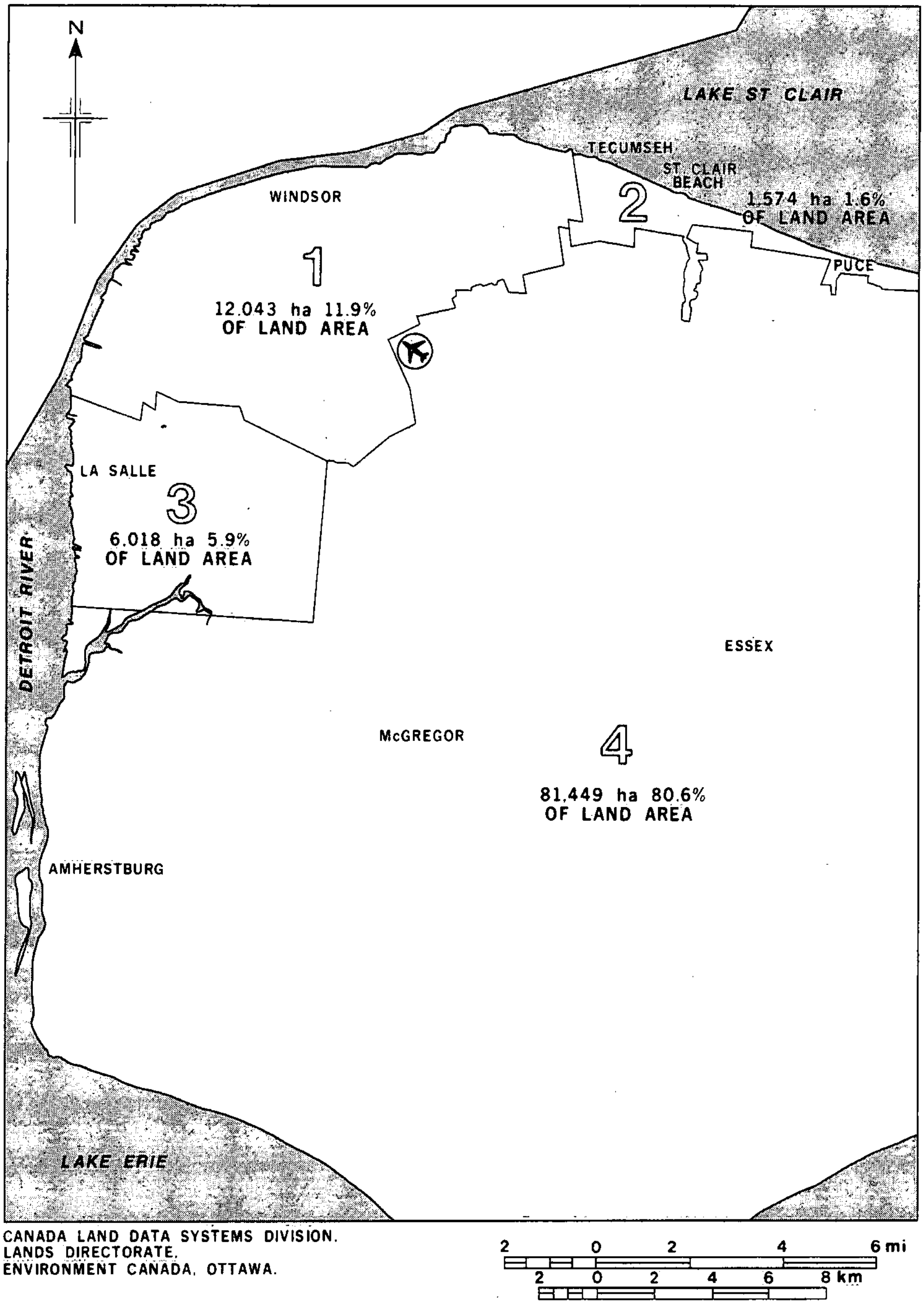
83°00'
82°30'
42°15'
42°00'
40J/6a
40J/7d
40J/7c
DETROIT
WINDSOR
Tecumseh
St. Clair Beach
LAKE ST CLAIR
Thames
River
Belle River
Puce
Little River
Pike Creek
Puce River
Turkey Ck.
Big Creek
Tilbury Ck.
Baptiste Creek
Tilbury
40J/3l
40J/2e
401
40J/2f
La Salle
Belle River
Ruscom River
Essex
McGregor
Trenton
Canard River
40J/2a
40J/2d
40J/2c
Gibraltar
Amherstburg
77
Cedar Ck.
Harrow
Kingsville
Leamington
18A
LAKE ERIE
MAP 1: WINDSOR STUDY AREA
Functional Study Area
SCALES
5 0 5 MILES
5 0 5 KILOMETRES
INDEX MAP
MANITOBA
HUDSON BAY
James Bay
ONTARIO
QUEBEC
U.S.A.
Lake Superior
Lake Michigan
Lake Huron
Windsor
Lake Erie
L. Ontario
N
SCALES
100 0 100 200 300 MILES
200 0 200 KILOMETRES

planned for Windsor lies in its immediate periphery, and it is this area which was examined in the study.

Data Overview

The data set for Windsor covers a land area of 101,084 hectares. Sectors form key spatial units for discussions of new residential developments. Each sector is a division of the metropolitan area into a subregion based on the direction or concentration of residential development delineated by political boundaries. Sector 1 is the core containing the City of Windsor; it is just over 12,000 hectares and constitutes 12 percent of the land area (Map 2). Sector 2, adjoining the eastern edge of the City of Windsor, includes Tecumseh and St. Clair Beach, and is the smallest, occupying 1.6 percent of the land area. The remaining area is composed of Sectors 3 and 4. Sector 3 includes the township of Sandwich West which forms Windsor's southwestern extension and accounts for six percent of the land area. Sector 4 is by far the largest and its 81,000 hectares account for 80 percent of the total land under study.[4] Sector 4 is comprised of the remaining townships which are largely rural in nature. This study is confined to the four sectors using the two identified data bases.

MAP 2. SECTOR BOUNDARIES OF THE WINDSOR STUDY AREA.



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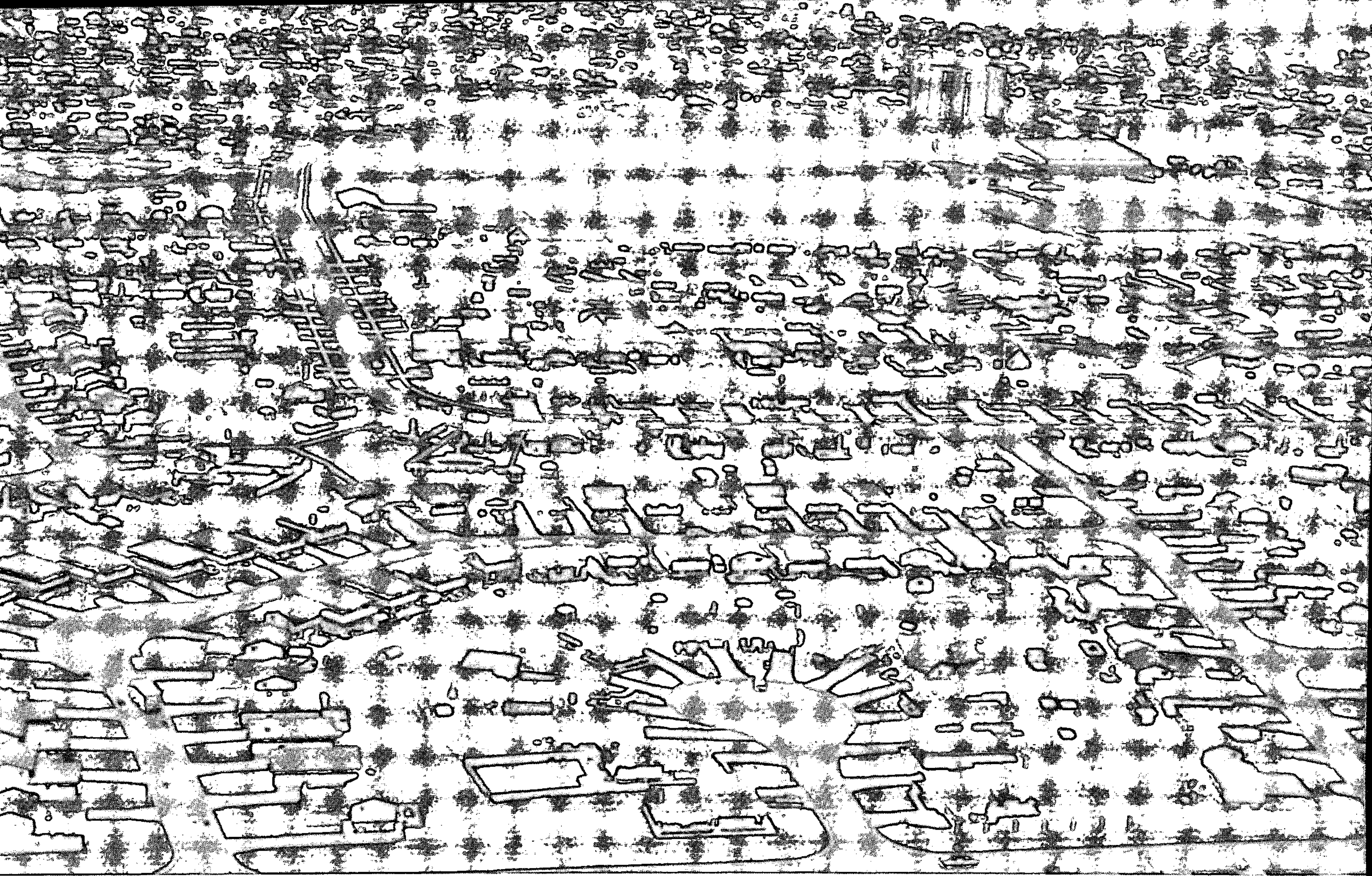
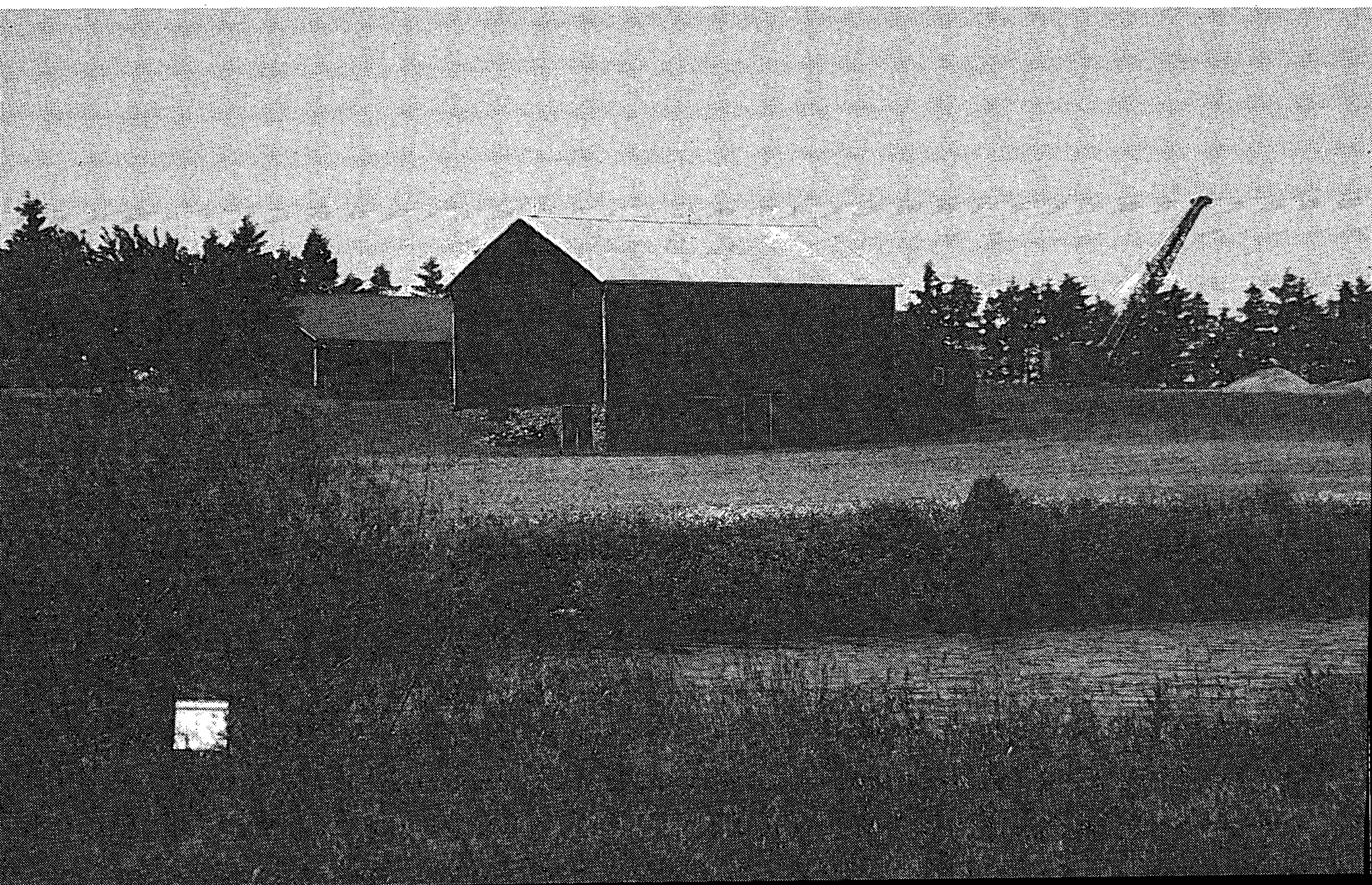
LANDS DIRECTORATE.
ENVIRONMENT CANADA, OTTAWA.





OPTIMAL USE OF THE LAND RESOURCE

In this section, the construction of a model for optimal land resource use is described; the criteria which constitute such a situation are defined and its application to the study area is outlined. By defining such an optimum, it is possible to measure the variations between the actual and the optimum. From that, it is possible to evaluate the implications and to identify potentially viable options.

In this section, optimal land resource use is described from a conceptual and national viewpoint. This viewpoint advocates that land use should be a positive reflection of the land's capability to support that use. Therefore, it is proposed that land should be used to its highest natural capability to maximize its long-term potential. There are, however, external influences which complicate such a proposal of which some of the more basic ones are described.

Land is fragmented into units individually owned and controlled by numerous levels of government (federal, provincial, regional, municipal, township, etc.), multinational or publicly owned corporations, private companies, developers, farmers, and other individuals. These multiple levels of land-ownership control and interact to define the use of land. The resulting pattern of cumulative individuals' use of land does not always emulate the best overall use of the land resource in accordance with its capability. The economic marketing and use of land are not based exclusively on land capability. Land ownership is delineated by artificial straight-line boundaries, whereas capability boundaries are based on irregular natural conditions; seldom do the two coincide. The demand for a particular type of land at any single point in time includes a number of complex exogenous factors. Each unit of land derives part of its value from its spatial relationship to all other units. For example, lands around cities may derive their value for housing in terms of their location to shops, schools, and place of work. Land may also possess certain public utilities which again increase its value beyond its simple physical capability. The presence or absence of piped services such as water, sewers, or electricity are some of the variables affecting its value.

The last complicating factor to be noted is that of high multiple land capability and its perception. Any unit of land may have a high capability for several uses, for example for both recreation and agriculture. The actual use to which it is put will depend on a variety of factors, not the least of which is supply and demand. Other external economic factors and land-use controls like zoning, also affect the actual use. As a result, capability may not in fact be the prime determinant of land use.

To introduce the concept of an optimal land-use pattern, the overall agricultural land capability for Windsor is described. However, the focal point of this section is the disclosure of an optimal model for land development and its application to the Windsor study. The criteria used as the basis for the optimal model are explained, analyzed, and modified to respond to local conditions.

Agricultural Capability

"Windsor is the gateway to Canada's diversified agricultural producing area; namely, Essex and Kent Counties. The two Counties are mainly cash crop, but with large concentration of fruit and vegetables. Due to the climate, the crops in this area are two to four weeks ahead of the remainder of Eastern Canada." (Corporation of the City of Windsor, 1970).

Over 95 percent of the study area is Classes 1, 2, or 3 agricultural land capability, indicating the overwhelming dominance of high-quality agricultural land. As shown in Table 1, Class 1 land amounts to 9,701.5 hectares and is present only in Sector 4. The total absence of Class 4 land for agriculture results in an abrupt dichotomy between lands suitable for prime agriculture and those of lower quality. The fact that such a high-quality resource dominates the region suggests that consideration of land quality should be important in land-use decisions. It is also recognized that developments and growth in this

TABLE 1. Agricultural Land Capability by Sector

CLI Class	Sector 1	2	3	4	Total Area	Percentage of Study Area
	hectares					%
1	0	0	0	9,701.5	9,701.5	
2	9,867.6	877.8	5,219.0	57,047.1	73,011.5	95.1
3	1,397.0	629.3	369.9	11,067.2	13,463.4	
4	0	0	0	0	0	
5	724.4	67.1	328.6	2,289.8	3,409.9	
6	0	0	0	34.7	34.7	
7	53.6	0	100.8	1,180.5	1,334.9	4.9
8	0.3	0	0	0.1	0.4	
0	0	0	0	127.4	127.4	
Total Area (ha)	12,042.9	1,574.2	6,018.3	81,448.3	101,083.7	
Percentage of Study Area %	11.9	1.6	5.9	80.6		100.0

area will have to consume some of the high-capability land. However, planning which recognizes high-capability agricultural lands can actively direct growth to areas of lower capability.

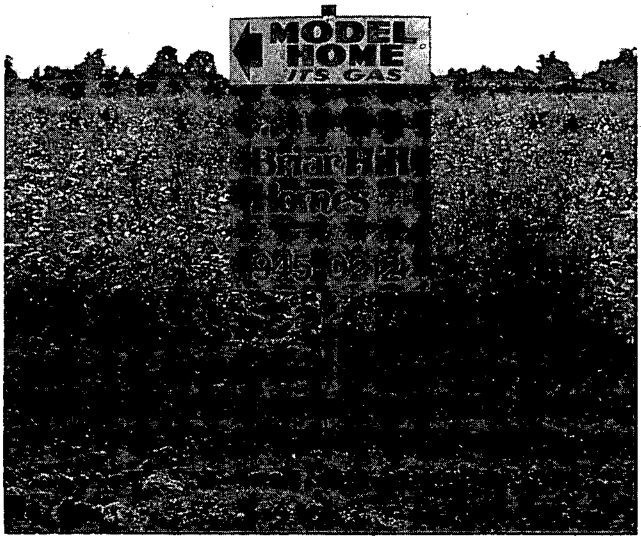
Current land uses prevent the possibility of using the full land potential. Despite the fact that the land which the City of Windsor presently occupies is of high agricultural capability, it is unlikely to revert from its present use to a rural landscape. Past decisions pre-empt certain future options.

Constructing the Optimal Development Model

"Once used for urban development the land is permanently lost for agricultural use. Obviously the better the agricultural quality of the land, the greater the loss of potential agricultural production. Therefore, most would accept, urban development should only be allowed to take rural land where absolutely necessary and then it should be directed to the land of the lowest quality." (Simmonds, 1979).

The land resource varies in its ability to support a particular use. In order to preserve the land base and its potential uses, it should be developed in harmony with its capability. All land surfaces have a capability for certain uses be they recreation, wildlife—waterfowl, forestry, or agriculture. The premise is that land should be developed in conjunction with its highest capability. A land area with a high capability for agriculture should be developed with this capability in mind.

On the periphery of urban centres, there exists an intense competition between users for the land resource. This complex competition is rarely resolved on the basis of land capability. Conflicts arise when land has the capability to support more than one use. For example, an intensive urban land use such as housing may economically outbid, in the short term, a less-intensive rural use such as farming. The land characteristics suited for each activity may be identical, thus magnifying the degree of conflict.



For the Windsor study, several choices for land use could be developed based on the agricultural land capability data. Assuming that development and land use should be reflective of land capability, much of the land area, as already shown, is ideally suited for agricultural production and should be retained in agricultural uses. However, from Table 1, it is evident that the City of Windsor itself is already an occupant of good agricultural land. So then it is only the choices for future growth that can consider land capability.

Based on the premise that the loss of good agricultural land should be minimized, lands of least agricultural capability ideally should be used whenever practical. However, land for urban development must also meet definite criteria to avoid difficulties and excessive costs for building and servicing.

First, several restrictions from the agriculture capability subclasses were selected as limitations to large-scale urban development; they include inundation by streams or lakes (subclass I); excess water or high water table (subclass W); adverse topography or sloping land (subclass T); and finally consolidated bedrock close to the surface (subclass R). Difficulties for construction form the rationale for selecting these as limitations to large-scale development. For instance, bedrock close to the surface means piped services and foundations require dynamiting, prohibiting large-scale development. Similarly, a high water table or inundation by water requires special waterproofed foundations which again are extremely expensive. Building on steep slopes creates instability which requires special construction methods. The costs of these methods make them inappropriate for erecting multiple housing.

Secondly, land use is applied as a qualifier to exclude areas which meet the capability criterion, yet which cannot be considered as available lands for new housing. Based on land-use information (1972) those excluded are lands already built up (B), in use for outdoor recreation (O), cropland (A), pasture (P), horticulture (H), orchards and vineyards (G), unmapped (B), and water areas (Z). The excluded land uses are either urban areas presently built up or constitute a use which ideally should be maintained.

By excluding the agricultural subclasses and land uses which should not be considered for future urban development, it is possible to identify the remaining areas which are potentially suitable and then to evaluate their agricultural potential (Table 2).

From Table 2, it is possible to quantify the supply of land available by its agricultural capability. Windsor's demand for land to accommodate growth in housing has traditionally been 125 hectares annually.[5] Using this figure as the annual demand for land, it is now possible to compare the potential supplies with the demand.

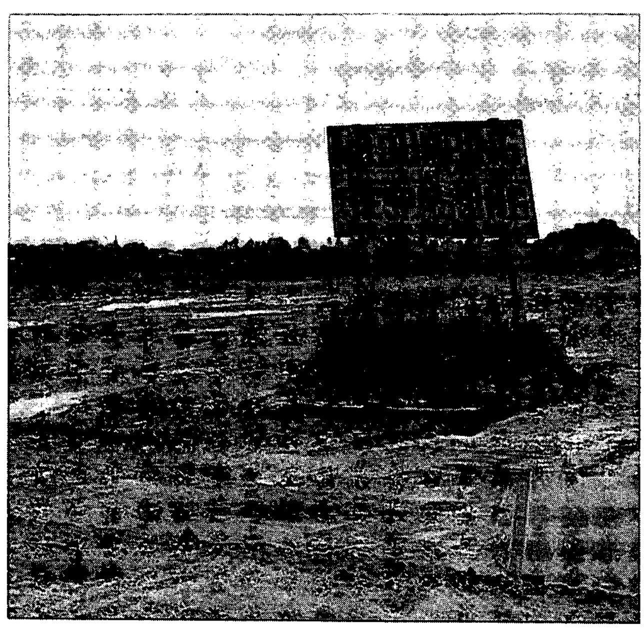


TABLE 2. Agricultural Capability of Lands Suitable for Urban Development*

CLI Class	Sector 1	2	3	4	Total Area
			hectares		
7	0	0	0	11.4	11.4
6	0	0	0	0	0
5	141.2	0	32.1	0	173.3
4	0	0	0	0	0
3	0.4	0	21.4	1,003.2	1,025.0
2	332.3	0	268.4	116.8	717.5

* Excluding areas of inundation by streams or lakes, shallowness to bedrock, adverse topography, or excess water and excluding land uses of urban built-up, outdoor recreation, cropland, pasture, horticulture, orchards and vineyards, water, and unmapped areas.

Land with lower agricultural potential (Classes 5, 6, and 7) is limited to just under 200 hectares. Table 3 shows the distribution of this land supply by sector and land use. Sector 1 predominates with 141 hectares of lower-class agricultural land, however the total amount of 185 hectares for all sectors is a supply sufficient for only one-and-a-half years growth. Therefore, to meet the demand for land over several years, residential growth must develop on some of the better-quality agricultural land. Since there is no Class 4 land in the study area, Class 3 land is included in the calculation to augment the available area to 1,210 hectares or about a ten-year land supply. Table 4 shows the distribution of this land supply by sector and land use.

From a national perspective, Class 3 agricultural land should be maintained for agricultural production. Yet, in the Windsor area there is no other land on which to grow, so that Class 3 land must be used as a trade off in order to maintain the highest-quality lands, namely those of Classes 1 and 2. One problem (shown in Map 3) is the scattered, and somewhat remote nature of some of the parcels of land in relation to the core of the city itself. In order to promote a contiguous land supply closer to the existing urban area, development may have to use Class 2 land as well (Table 5).

In this case, of the total 1,927 hectares, some 796 hectares were located in Sectors 1 and 3. The Sector 1 and 3 portions constitute land within the City of Windsor, close to existing urban development, services, and infrastructure. Potentially, this amount of land could supply room for new housing construction for about six and a half years in these two sectors.

The Optimal Development Model

To construct an optimal development model, it is necessary to piece together the various selections to form a composite of the lands which are considered most appropriate for settlement without impairing the highest-capability agricultural land.

Using the defined ideal, there are two possible patterns of development which could provide sufficient land supply for Windsor's growth. One is to select the Class 3 to 7 lands, and the second is to expand

TABLE 3. Lands of Lowest Agricultural Capability Suitable for Development Excluding Selected Land Uses*

Present Land Use 1972	Sector				Total Area	Percentage of Lands in Classes 5, 6, & 7
	1	2	3	4		
	hectares					%
Unimproved Pasture and Rangeland	31.1	0	0	4.4	35.5	19.2
Productive Woodland	32.4	0	10.9	3.1	46.4	25.1
Mines and Quarries	36.8	0	1.0	0	37.8	20.5
Nonproductive Woodland	38.7	0	20.2	0	58.9	31.9
Swamp and Marsh	2.2	0	0	3.9	6.1	3.3
Total	141.2	0	32.1	11.4	184.7	100.0

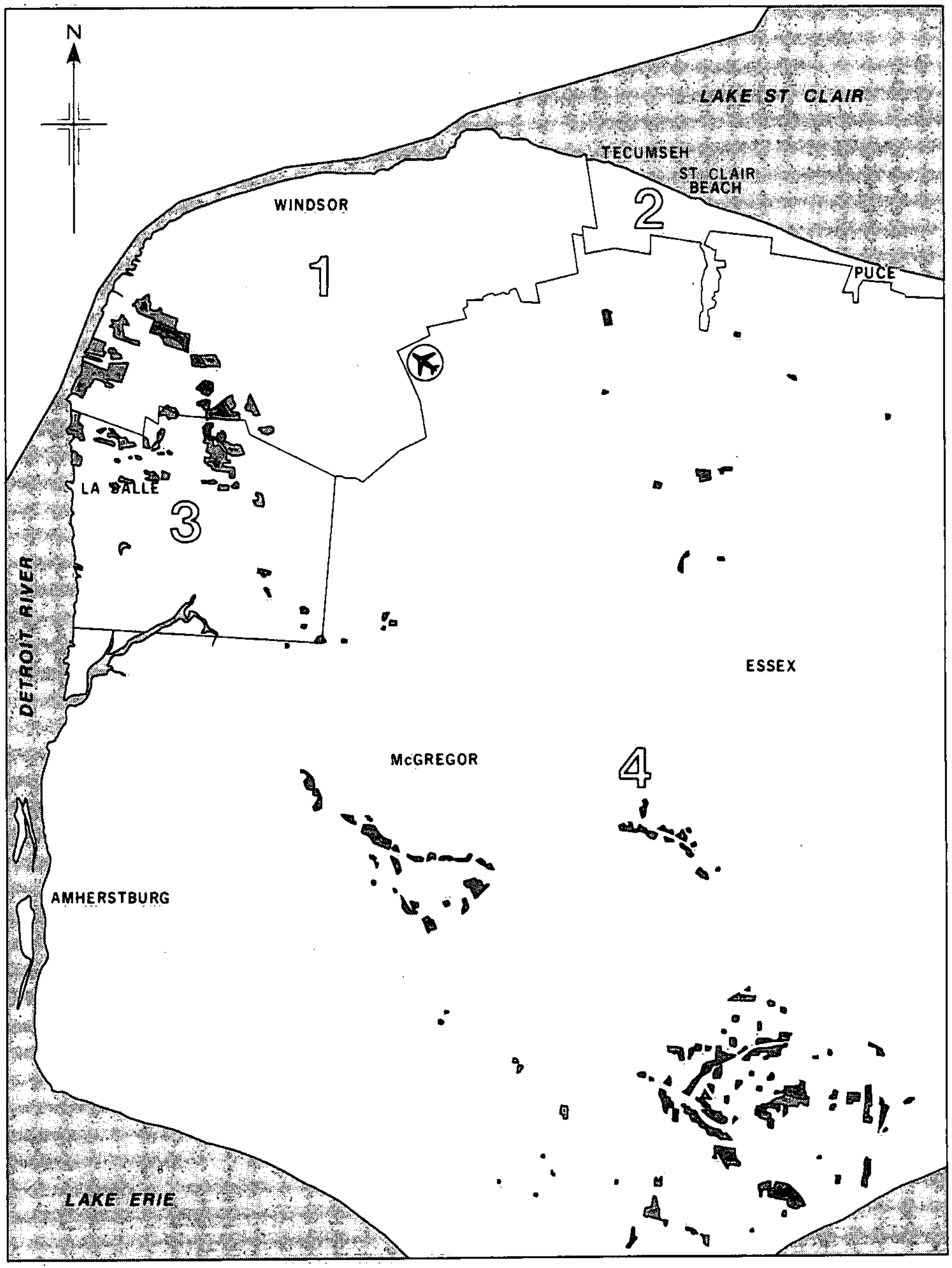
* Agricultural land capability Classes 5, 6, and 7 with agricultural subclasses excluding inundation by streams or lakes, shallowness to bedrock, adverse topography, or excess water and land uses other than urban built-up, outdoor recreation, cropland, pasture, horticulture, orchards and vineyards, water, and unmapped areas.

TABLE 4. Lands of Moderate and Lowest Agricultural Capability Suitable for Development Excluding Selected Land Uses*

Present Land Use 1972	Sector				Total Area	Percentage of Lands in Classes 3, 5, 6, & 7
	1	2	3	4		
	hectares					%
Productive Woodland	32.4	0	21.8	671.0	725.2	60.0
Unimproved Pasture and Rangeland	31.1	0	8.4	120.6	160.1	13.2
Mines and Quarries	36.8	0	1.0	0	37.8	3.1
Nonproductive Woodland	39.1	0	22.3	211.9	273.3	22.6
Swamp and Marsh	2.2	0	0	5.0	7.2	.6
Transportation	0	0	0	6.1	6.1	.5
Total	141.6	0	53.5	1,014.6	1,209.7	100.0

* Agricultural land capability Classes 3, 5, 6, and 7 with agricultural subclasses excluding inundation by streams or lakes, shallowness to bedrock, adverse topography, or excess water and land uses other than urban built-up, outdoor recreation, cropland, pasture, horticulture, orchards and vineyards, water, and unmapped areas.

MAP 3. OPTIMAL DEVELOPMENT MODEL: COMBINING LANDS OF LOW, MODERATE AND HIGH AGRICULTURAL CAPABILITY SUITABLE FOR DEVELOPMENT EXCLUDING SELECTED LAND USES.*



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AGRICULTURAL CAPABILITY CLASS 2 LANDS

AGRICULTURAL CAPABILITY CLASS 3, 4, 5, 6 AND 7 LANDS

*AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7, WITH SUBCLASSES OTHER THAN INUNDATION BY STREAMS OR LAKES, EXCESS WATER, SHALLOWNESS TO BEDROCK OR ADVERSE TOPOGRAPHY, AND LAND USES OTHER THAN URBAN BUILT-UP, OUTDOOR RECREATION, CROPLAND, HORTICULTURE, PASTURE, ORCHARDS AND VINEYARDS, WATER AND UNMAPPED AREAS.

TABLE 5. Optimal Development Model: Combining Lands of Low, Moderate and High Agricultural Capability Suitable for Development Excluding Selected Land Uses*

Present Land Use 1972	Sector				Total Area	Percentage of Lands in Classes 2, 3, 5, 6, & 7
	1	2	3	4		
	hectares					%
Productive Woodland	103.2	0	170.3	781.6	1,055.1	54.7
Unimproved Pasture and Rangeland	203.9	0	62.0	120.6	386.5	20.1
Mines and Quarries	68.7	0	6.2	0	74.9	3.9
Nonproductive Woodland	95.4	0	62.4	217.1	374.9	19.5
Swamp and Marsh	2.7	0	21.0	6.0	29.7	1.5
Transportation	0	0	0	6.1	6.1	.3
Total	473.9	0	321.9	1,131.4	1,927.2	100.0

* Agricultural land capability Classes 2, 3, 5, 6, and 7 with agricultural subclasses excluding inundation by streams or lakes, shallowness to bedrock, adverse topography, or excess water and land uses other than urban built-up, outdoor recreation, cropland, pasture, horticulture, orchards and vineyards, water, and unmapped areas.

this selection to include Class 2 lands (see Map 3). The overall pattern which emerges is similar in both cases. The greatest important differential between the two selections is the amount of land available for development in the sectors closest to the core of Windsor itself. To preserve the highest-capability agricultural land, optimal growth should be in Sectors 1 and 3. By using only Class 3 to 7 lands in the already semi-urbanized Sectors of 1 and 3, there is a land supply sufficient for only a one-and-a-half-year period. If, on the other hand, Class 2 land is included, Windsor's growth can be accommodated for six and a half years within these same sectors. Containing growth within Sectors 1 and 3 conforms to the concept of contiguous urban development. Since this land is no longer in agricultural production, allocating it to planned urban growth is perhaps the better option and thereby relieve pressures on lands of similar capability presently in production elsewhere on the periphery.

Sector 4 is predominately rural farmland and is far removed from Windsor's core, but when land with the potential for development is added from this Sector a much greater supply of land exists. The total supply for all sectors using exclusively Class 3 to 7 lands can meet Windsor's residential growth needs for ten years. However, these development lands in Sector 4 present a problem because they are fragmented and lie some 30 kilometres from the present infrastructure system of Windsor. If development were to take place, it would inevitably spread growth beyond the individual pockets and onto the surrounding prime agricultural land. The scattered pattern of development pockets again violates the concept of contiguous urban development.

Consequently, the optimal model for development would be the following:

—protection of all Class 1 agricultural lands;

—initial development of Sectors 1 and 3 on lands of Classes 2 to 7 (commencing with the least-productive land); and

—development in Sector 4 should be limited to Class 3 to 7 lands with close monitoring to avoid spillover effects on Class 2 lands.

On the basis of past trends, this strategy would assure a six-and-a-half-year supply of residential land, comprising 756 hectares.

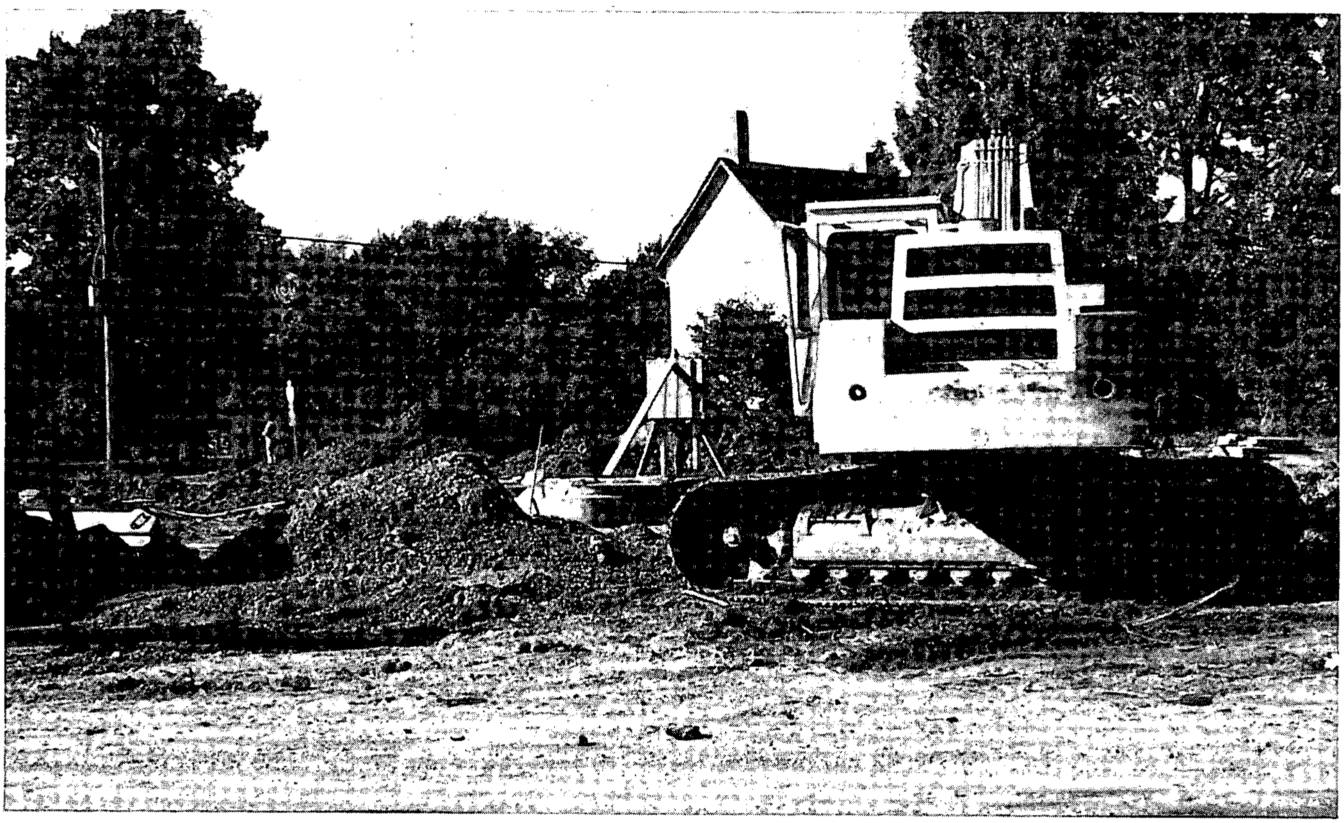
ACTUAL DEVELOPMENT

The focus here is on the land actually undergoing development in Windsor, as determined from CMHC's Land and Infrastructure Mapping Program. The Program inventories lands which have potential for residential development based upon servicing, planning, and ownership criteria. Because the investment in infrastructure is an indicator of urban development, information on piped services can be used to understand the current growth patterns. In addition, proposed investments in infrastructure indicate the direction and the shape that future regional expansion may take.

The Sequence of Analysis

The subsequent analysis of actual development uses information on sewers and subdivision plans, as indicators of the location and extent of present and imminent growth. Land development is classified into three stages using the first infrastructure characteristic, sewers.

The first stage includes those lands with sewers on or close to the site; these characteristics identify areas of current development. The second stage concentrates on lands where sewers are planned; these are the areas of proposed development. The third stage examines those developable lands without sewers, which identifies lands held for development (*see* Appendix IV for a definition of terms). The assumption here is that lands which have sewers on or close to the site will be developed before those lands without. Since sewer installation incurs additional time and money for planning and construction, the complete price for servicing is very high. The servicing of land reflects policy and planning for development by the authorities concerned.



A second characteristic, the subdivision plan status is used in conjunction with sewer characteristics to examine the stages of development. These two land characteristics are used to analyze the successive steps of the development process in Windsor.

The subdivision status of any land area indicates the exact position of a parcel of land in both the development and planning process. The subdivision plan details the type of development proposed, the lot size, the required services (water, sewage treatment, storm drainage, and location of access routes) description of vegetation, topography, and existing land use. All of the above must adhere to the policies of the official plan.

Initially, the subdivision plan is submitted by the developer to the municipal approval authority to be sure that it complies with the zoning by-laws and the official plan of the municipality. Once the municipality agrees that the subdivision plan complies with the official plan, the developer then files an application for approval with the Ontario Ministry of Housing. The Ministry then circulates the plan internally for comments as well as to the municipality for their criticisms. After all the requirements are met satisfactorily, the final proposal is made and the Ontario Ministry of Housing approves the subdivision plan.

Development is imminent when a subdivision plan is approved. The specified land area may have sewer characteristics of either on or close to site, planned publicly, or planned privately for the site.

When a subdivision plan is submitted, the sewer characteristics of either on or close to site, planned publicly, or planned privately for the site may apply. But development on that land cannot proceed until approval is given, thus the time frame for approval and its relationship to servicing is very important for developers.

The lands that have no subdivision plans, yet are held by developers, are the lands where future development can be most readily influenced if trunk sewers are not already in the ground. The lands in this stage of the planning process have the greatest opportunity to be evaluated; as a result, those of high agricultural capability can be identified and possibly preserved.

To assist the reader in following the sequence of analysis, a matrix of the two characteristics discussed is graphically noted at the beginning of each sub-section. The sewer status is on the Y axis of the matrix and the subdivision plan status is on the X axis. The content of the section is indicated by an X marked in the appropriate cells within the matrix.

Sample blank matrix:

		SUBDIVISION PLAN STATUS		
		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE			
	PLANNED			
	NONE			

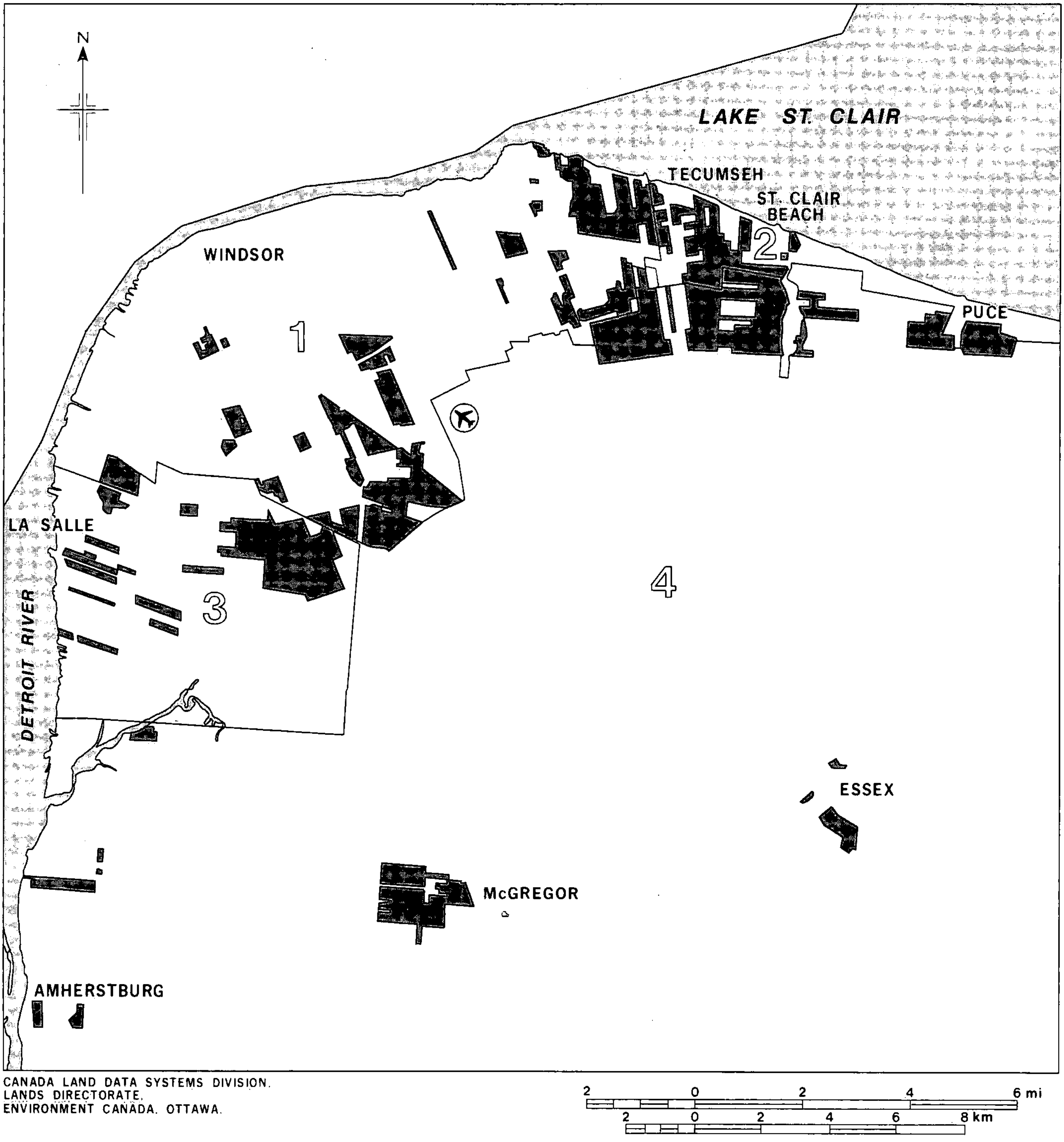
The Analysis

To examine land to be developed in the near future within the Windsor study area, it is necessary to select the types of land ownerships which permit and encourage development: private developable and public developable. These are the lands for which Canada Mortgage and Housing Corporation has gathered information on land and infrastructure. Public developable lands are vacant parcels of publicly owned land in areas designated for residential growth, or government land assemblies intended for residential development. Private developable lands are those parcels held by known developers interested in fostering development. Further mention of the term "developable land" refers only to private developable and public developable land ownerships. Map 4 displays all the developable land which amounts to 4,963 hectares or five percent of the total study area. Although the percentage may appear small, it is important to realize that development is cumulative and over time could occupy a substantial amount of the entire land area.

As any urban area grows it consumes a part of the land resource. The option as to what portion of that land will be expended, depends on the relative development potential one parcel has to another. From a market place perspective, the developer will naturally select land parcels which will permit construction at the lowest possible cost while earning the greatest benefit from the dollar investment.

Lands are examined sequentially in this study. First, those with available sewers (on or close to site) and their respective subdivision plan status; secondly,

MAP 4. PRIVATE DEVELOPABLE AND PUBLIC DEVELOPABLE LANDS.



PRIVATE DEVELOPABLE AND PUBLIC DEVELOPABLE LANDS.

lands where sewers are planned; and finally, sites without sewers are examined.

Lands with sewers on or close to site

"Growth seems to be created by the installation of new infrastructure; actually, the infrastructure merely concentrates growth which might otherwise have been located elsewhere in the region." (Urban Systems Research & Engineering Inc., 1976)

The first examination must be of those private and public developable lands which have sewers on or close to the land parcel. The majority of residential development occurs on those lands which already have the infrastructure investments, such as sewers, supplied. Sewer investments are a major expense in the development process, so it follows that in general, lands with sewers have a higher price tag than those without. Since sewers demand lead time in planning, approval, and construction, they are major time consumers in the process of development from open land to medium-density serviced residential land. This study focuses only on piped sewer services and excludes other development factors.

In Windsor, 28 percent (1,412 hectares) of the developable lands have sewers on or close, almost 50 percent have no sewers at all, and the remainder have sewers planned. Development should first focus on this 28 percent of the developable land. The distribution of lands with sewers on or close is such that Sector 1 predominates with 75 percent (1,052 hectares) of the land with sewers on or close, followed by Sector 2 with 16 percent (231 hectares), Sector 4 has nine percent (129 hectares), and Sector 3 has none. The distribution indicates that Sectors 1 and 2 have the greatest amount of imminently developable land and are, in fact, historically the two sectors that have undergone the most extensive urbanization. However, the mere presence of a sewer does not explain the current development status of a parcel of land; its position in the land planning and approval process is important.

Lands with sewers on or close and subdivision plans approved

		SUBDIVISION PLAN STATUS		
		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE	X		
	PLANNED			
	NONE			

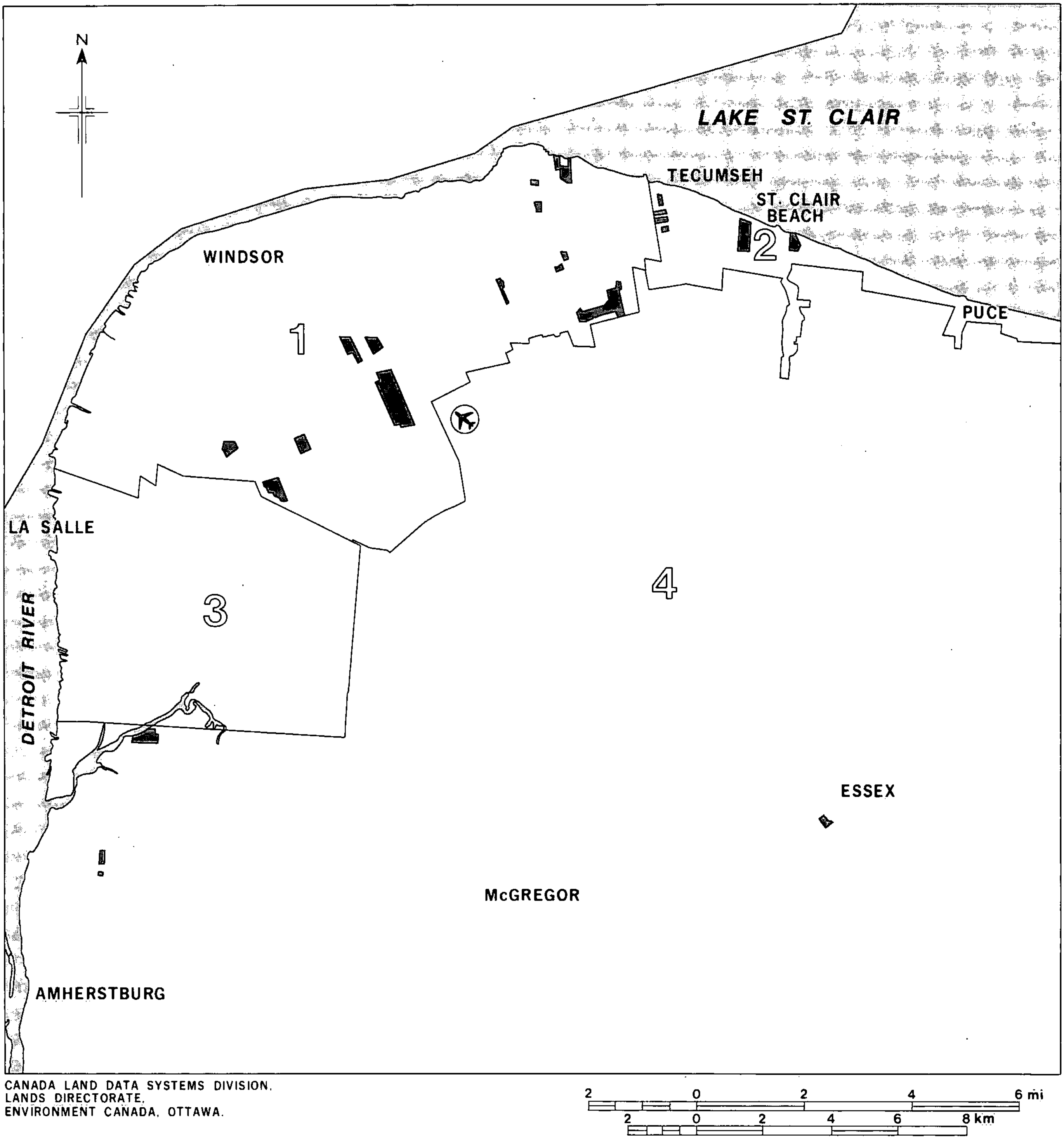
The subdivision plan status of a piece of land is added to examine current development. Of those lands with sewers on or close, 307 hectares have subdivision plans approved and their distribution is that Sector 1 has 205 hectares (67 percent), Sector 2 has 63 hectares (20 percent), and Sector 4 has 40 hectares (13 percent). These lands are already in the process of development and can be considered removed from the future developable land supply (Map 5).

Lands with sewers on or close and subdivision plans submitted

		SUBDIVISION PLAN STATUS		
		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE		X	
	PLANNED			
	NONE			

Of those lands with sewers on or close, 382 hectares have subdivision plans submitted and therefore have entered the approval procedure. Fifty-six percent of those land parcels with subdivision plans submitted are in Sector 1, 30 percent in Sector 2, and 14 percent in Sector 4. Once again Sector 3 is devoid of current development as there are no parcels with sewers on or close and subdivision plans submitted.

MAP 5. SEWERED LANDS APPROVED FOR SUBDIVISION.



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■ DEVELOPABLE LANDS WITH SEWERS ON OR CLOSE AND SUBDIVISION PLANS APPROVED

Lands with sewers on or close and subdivision plans approved or submitted

SUBDIVISION PLAN STATUS → SEWER STATUS		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE	X	X	
	PLANNED			
	NONE			

By combining the preceding selections, those parcels with sewers on or close and subdivision plans both approved and submitted can be examined as the lands next awaiting development. Map 6 shows the distribution of the 689 hectares of this land: Sector 1 with 417 hectares (61 percent), Sector 2 with 179 hectares (26 percent), and Sector 4 with 93 hectares (13 percent). This particular land accounts for 14 percent of the total developable land area as shown previously in Map 5. From Map 6, it is clear that most of the sewered development activity is occurring in Sectors 1 and 2, with only a few scattered development parcels in Sector 4. There is no activity in Sector 3 which meets the sewer and subdivision plan criteria. Generally, development in Windsor is occurring close to the urban core in South Windsor and eastwards to the periphery of Windsor in the St. Clair Beach area.

Lands with sewers on or close and no subdivision plans

SUBDIVISION PLAN STATUS → SEWER STATUS		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE			X
	PLANNED			
	NONE			

Those lands with sewers on and close but as yet with no subdivision plans total 723 hectares; this indicates that 50 percent of all the land parcels with sewers on or close do not yet have approved or submitted subdivision plans. This is a considerable amount of land to lie idle in terms of development and yet have sewers present. Eighty-eight percent of these land parcels are in Sector 1, seven percent in Sector 2, and five percent in Sector 4. These lands will no doubt be developed first as the infrastructure investments have already been made and they are located within the present built-up area.

Lands with sewers planned

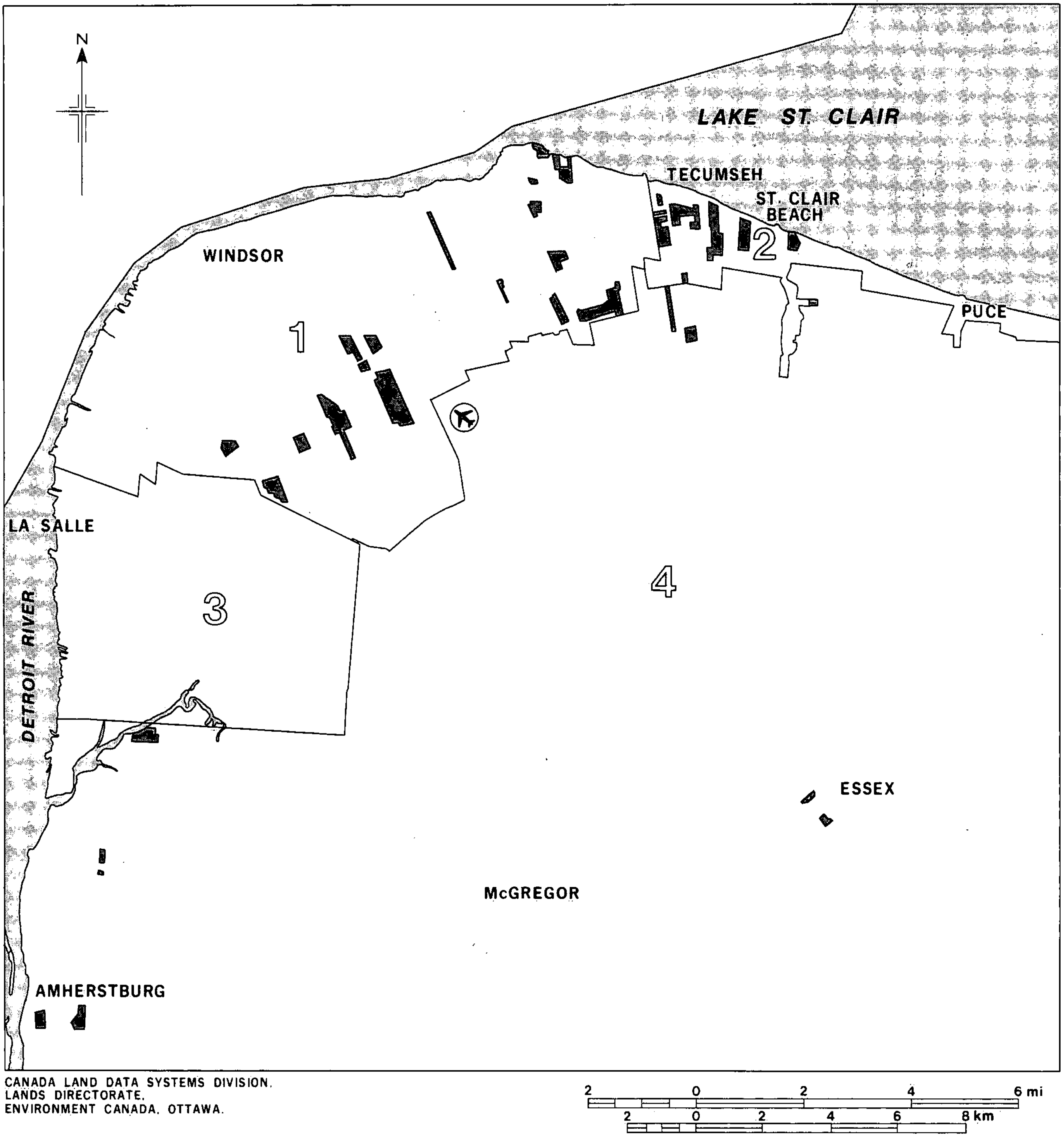
"The careful design and construction of infrastructure can help achieve well organized, environmentally sound urban growth." (Urban Systems Research & Engineering Inc., 1976)

The next land parcels to be considered are those with sewers planned; these lands represent the areas to which future growth is directed. The course which this growth takes is not so much determined by developers but by the planners who formulate decisions as to where and when trunk-lines are to be installed or extended. Neither Sector 1 nor 2 have any land parcels with sewers planned. However, both Sectors 3 and 4 have considerable amounts of land for which sewers are planned, 302 hectares and 442 hectares respectively. Map 7 displays the land parcels with sewers planned and provides an indication of where future growth is directed: namely to McGregor, Puce, and Emeryville in Sector 4, and to the West Oliver Project and the LaSalle Area in Sector 3. These are land parcels situated outside the urban built-up area and are examined in greater detail in the next section.

Lands with sewers planned and subdivision plans submitted or no subdivision plans

SUBDIVISION PLAN STATUS → SEWER STATUS		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE			
	PLANNED		X	X
	NONE			

MAP 6. SEWERED LANDS WITH SUBDIVISION PLANS APPROVED AND SUBMITTED.



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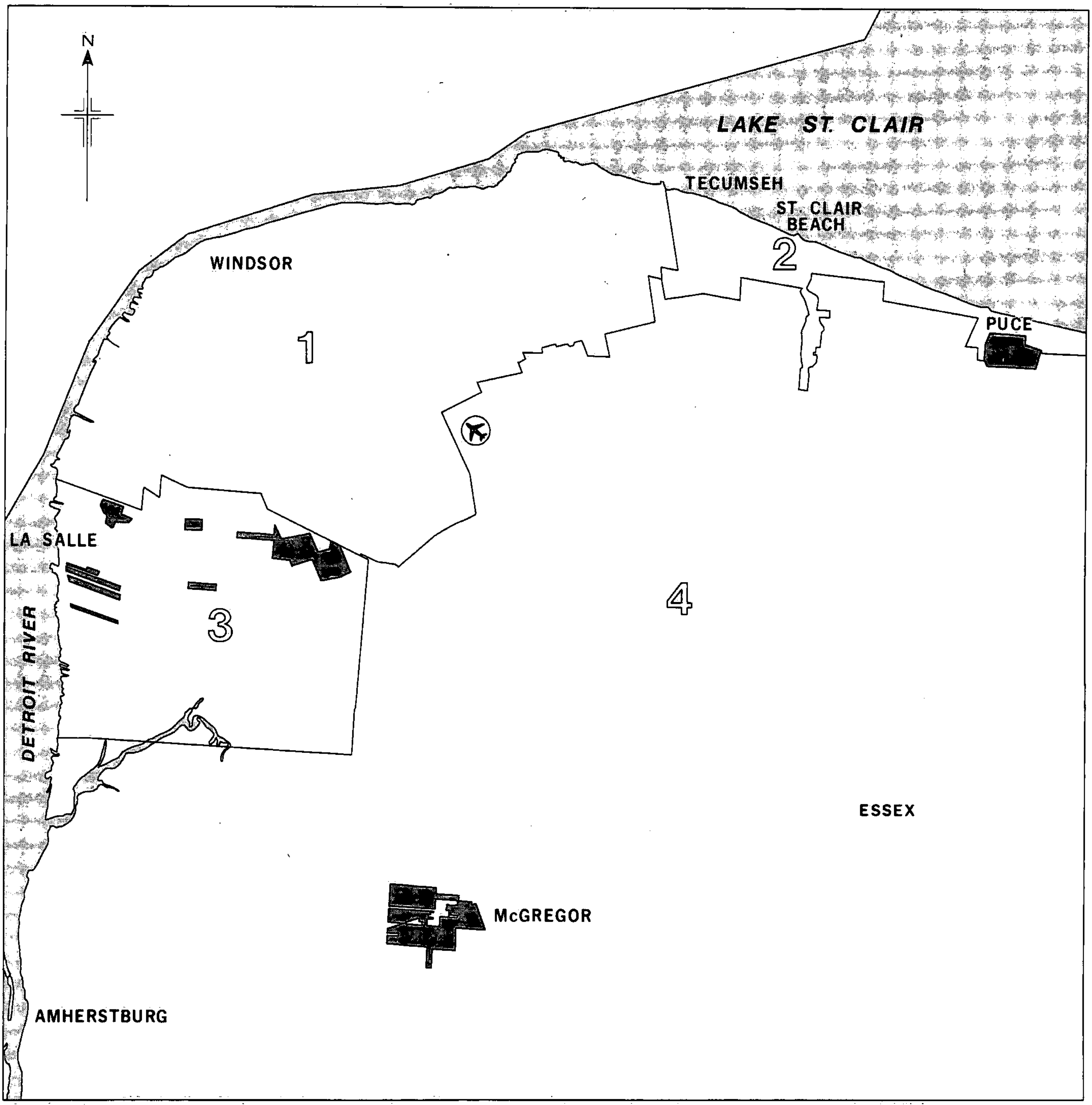
■ DEVELOPABLE LANDS WITH SEWERS ON AND CLOSE AND SUBDIVISION PLANS APPROVED AND SUBMITTED

MAP 7. LANDS WITH SEWERS PLANNED



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DEVELOPABLE LANDS WITH SEWERS PLANNED

Of the land parcels with sewers planned, 87 percent (648 hectares) have no subdivision plans as yet. The remaining 13 percent (97 hectares) have subdivision plans submitted, but none of these lands have subdivision plans approved. Those parcels with sewers planned and subdivision plans submitted are located in Sector 3 in the Oliver Project Area and directly west of that area.

Lands without sewers

SUBDIVISION PLAN STATUS

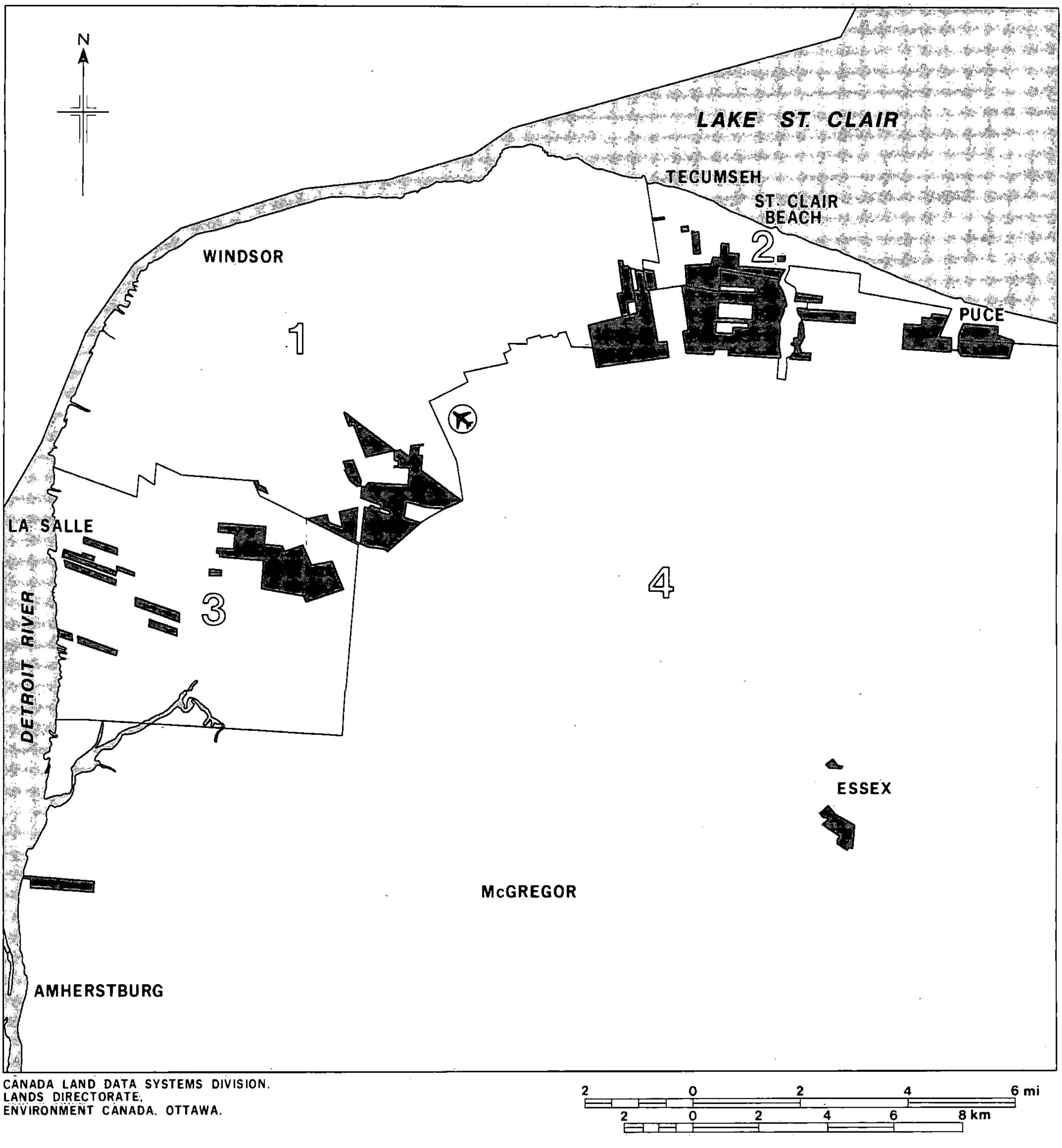
SEWER STATUS		APPROVED	SUBMITTED	NONE
SEWER STATUS	ON/CLOSE			
	PLANNED			
	NONE		X	X

The amount of developable land with no sewers totals 2,431 hectares (Map 8). This reveals that 50 percent of the developable lands are without sewers. The distribution of those developable lands without sewers is as follows: in Sector 1, 488 hectares, in Sector 2, 176 hectares, in Sector 3, 527 hectares, and in Sector 4, 1,240 hectares. Of these lands, 94 percent or 2,288 hectares have no subdivision plans at all, six percent or 143 hectares have subdivision plans submitted, and none have subdivision plans approved. This indicates that developers are holding a large amount of unserviced land, and their presence exerts pressure for development to proceed on this land.

Summary

Table 6 represents a summary of this section. It shows that Sector 1 has the greatest amount of land with sewers on or close, Sectors 2 and 4 have smaller amounts, and Sector 3 has none. Therefore, most of the current development is occurring in Sector 1. However, when considering future development areas where sewers are planned, Sectors 3 and 4 emerge as the growth sectors. Half of the developable land is still without sewers, so its future development is, as yet, undecided and, hence, is open to influence. The next section discusses lands in the various development stages in terms of their land capability.

MAP 8. LANDS WITHOUT SEWERS

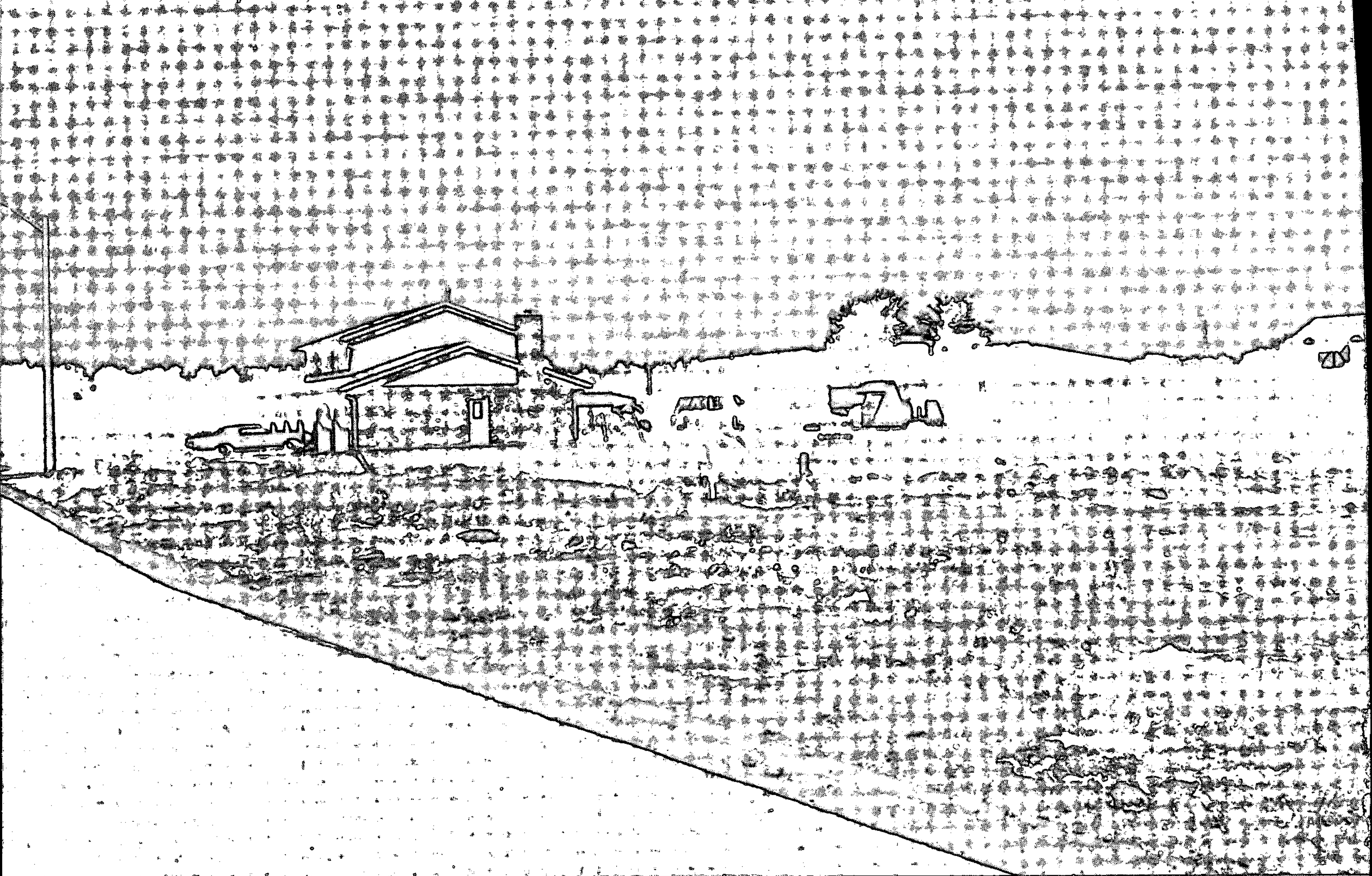
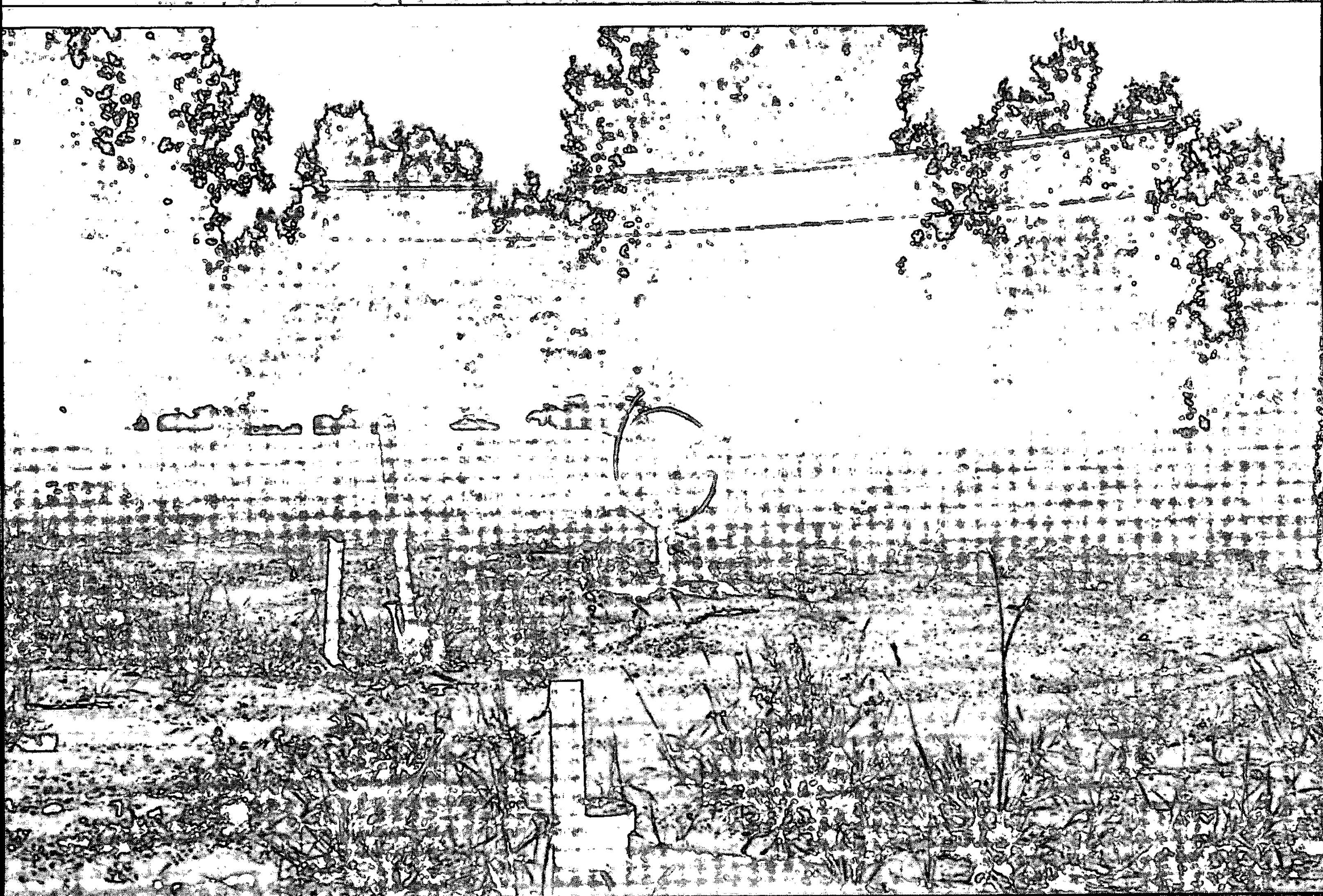


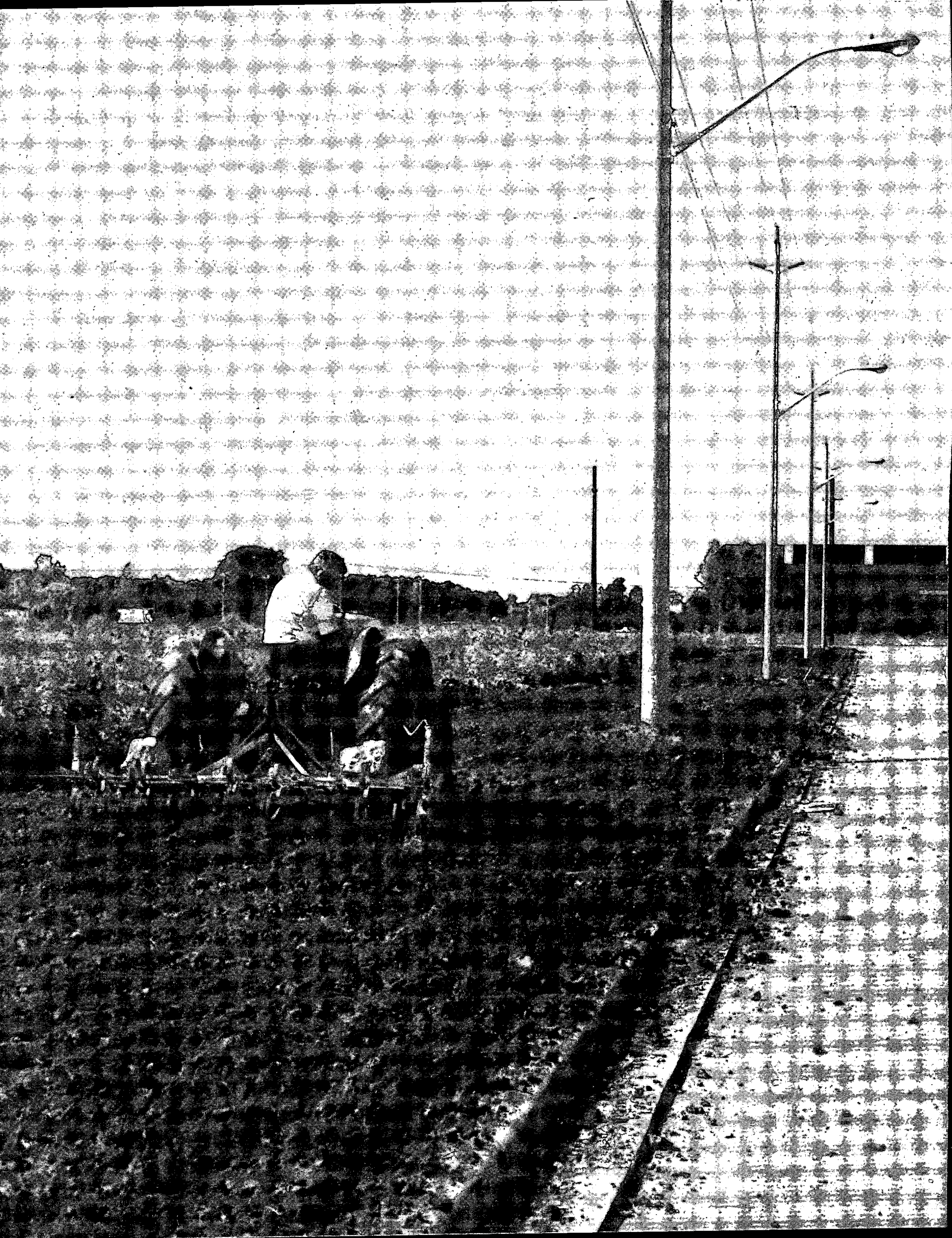
DEVELOPABLE LANDS WITHOUT SEWERS AND WITH SUBDIVISION PLANS SUBMITTED OR NO SUBDIVISION PLANS.

Table 6. Sewer Characteristics and Subdivision Plan Status for Developable Lands by Sector

Sector	Sewers on or Close				Sewers Planned				No Sewers			
	Subdivision Plans Approved	Subdivision Plans Submitted	No Subdivision Plans	Total	Subdivision Plans Approved	Subdivision Plans Submitted	No Subdivision Plans	Total	Subdivision Plans Approved	Subdivision Plans Submitted	No Subdivision Plans	Total
						(hectares)						
1	204.7	212.5	634.6*	1,051.8	0	0	0	0	0	14.1	473.7	487.8
2	62.5	116.4	52.5	231.4	0	0	0	0	0	53.5	122.1	175.6
3	0	0	0	0	0	96.5	205.8	302.3	0	19.7	507.3	527.0
4	40.1	52.9	36.1	129.1	0	0	442.1	442.1	0	55.7	1,184.5	1,240.3
Total	307.3	381.8	723.2	1,412.3	0	96.5	647.9	744.4	0	143.0	2,287.6	2,430.7

* Includes 9.4 hectares of developable land without subdivision plan status.



THE AGRICULTURAL CAPABILITY OF THE LANDS IN THE ACTUAL STAGES OF DEVELOPMENT

In this section, the agricultural capability is examined for those lands subject to development in the Windsor area. The investigation is conducted according to the three predefined stages of development. This allows an identification of the agricultural capability of the lands under current development, proposed for development, and held for development. This information indicates how the planning of infrastructure relates to agricultural land capability. In this section, land capability is frequently discussed in association with land use to produce a more realistic picture of the landscape. The link between Canada Land Inventory data and Canada Mortgage and Housing Corporation's Land and Infrastructure Mapping Program using the Canada Land Data System, permits the investigation of land holdings, their quality, and use.

Current Development

When examined in terms of their agricultural land capability and land use as of 1972, those developable lands which have sewers on or close produced interesting results. These lands under current development cover 1,412 hectares of which 82 percent or 1,151 hectares are of Class 1 and 2 agricultural land capability, 157 hectares are of Class 3, and 104 hectares are of Class 5 (Figure 2). It is revealing to find that 74 percent of such lands with sewers were defined as active cropland in 1972. Clearly, most of those lands which are under urban development pressures are both of high agricultural land capability, and have been actively cropped.

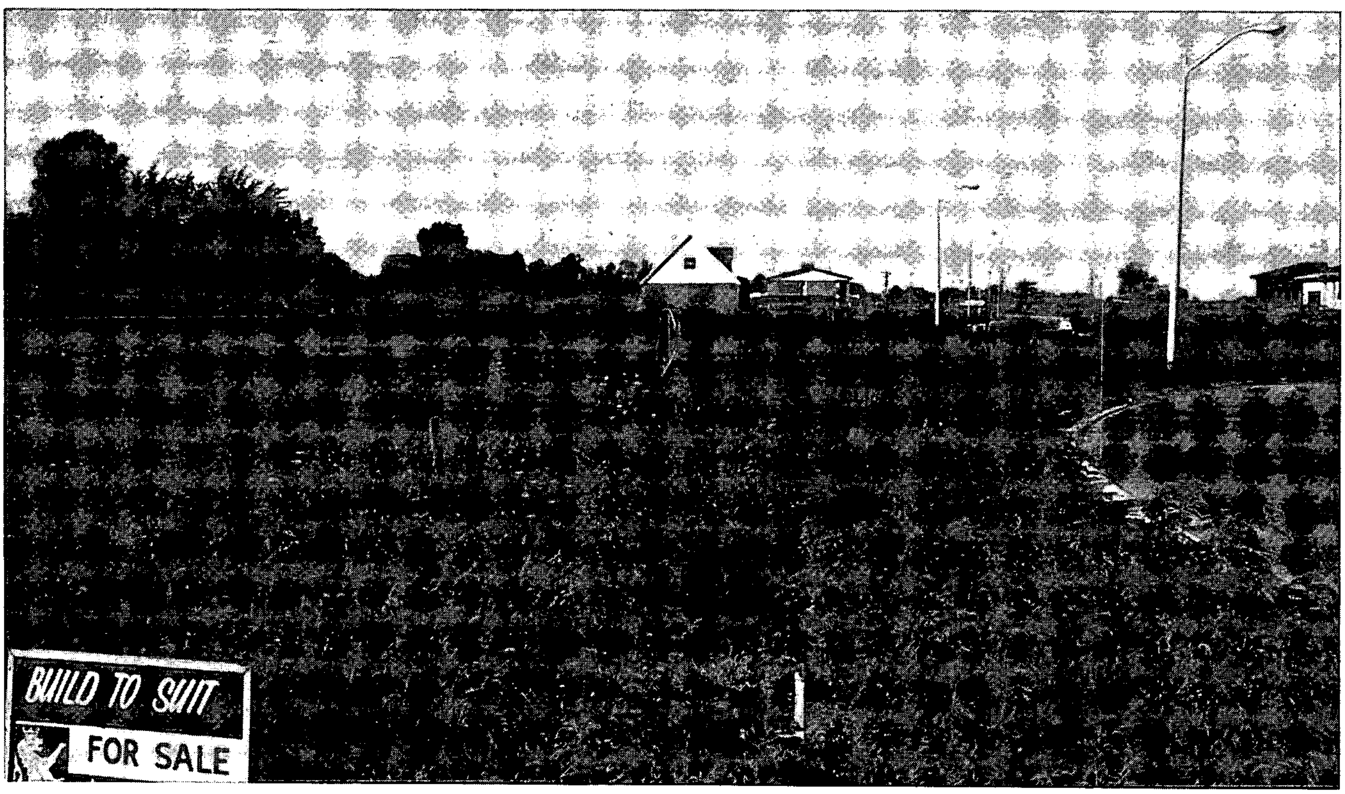
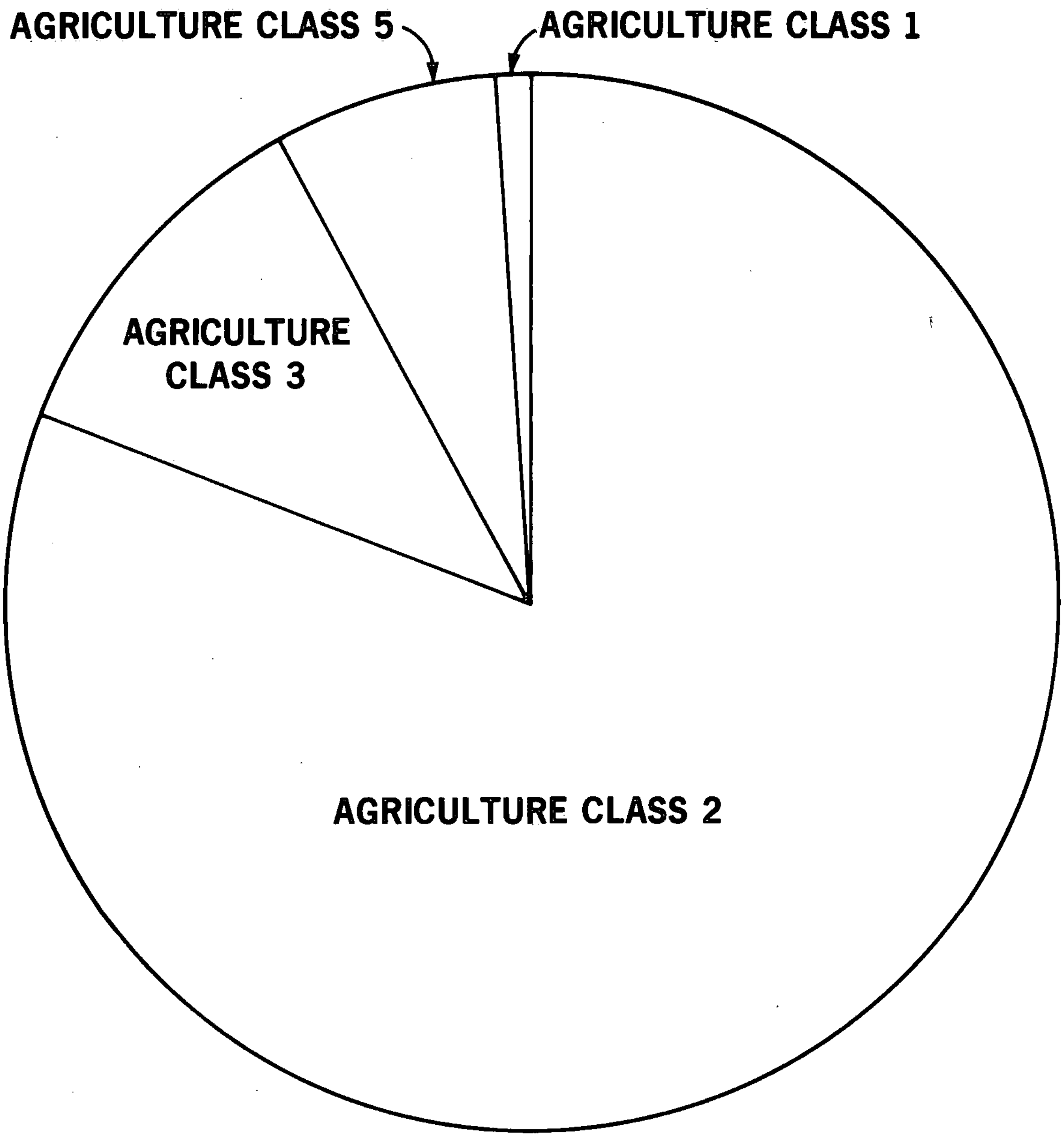


Figure 2. Current Development of Lands with Sewers and their Agricultural Capability*



TOTAL AREA = 1 412 hectares

*Percentage of Private and Public Developable Lands with available sewers (on or close) in relation to agricultural land capability.

Subdivision Plan Status

It is important to see how far along in the subdivision planning process are most of these lands with sewers. To accomplish this, the status of their subdivision plans must be investigated by tabulating their plan status. In total, 307 hectares of land with sewers on and close have received subdivision plan approval. The overwhelming majority have been on Class 1 or 2 land, in fact, 76 percent of approvals are on Class 1 and 2 lands, 19 percent on Class 3, and five percent on Class 5. Similarly, of submitted plans, 89 percent occupied Class 1 and 2 lands and eleven percent Class 3. Clearly, good-quality agricultural lands are being developed into residential communities despite their land capability.

Half of the developable lands with sewers on or close have no subdivision plans as yet. Eighty-one percent of these land parcels are on Class 2 land, six percent on Class 3, and twelve percent on Class 5. Approximately 85 percent of such land was active cropland in 1972, while ten percent lay within the urban built-up area.

"Understanding the future implications is necessary since many land use decisions are essentially irreversible and may result in terminal impacts on natural resources. Where land has the potential for several resource uses, a sequence of uses should be considered to permit full utilization of available resources before a terminal use is reached. Planning must become an integral part of decision-making in private and public sectors." (Soil Conservation Society of America, 1978)

The pie diagram (Figure 3) represents the total amount of developable lands with sewers on or close, not only in terms of their land quality, but also their planning approval status by each agricultural class. This total is divided proportionally into the agricultural capability classes and further by subdivision plan status. When subdivision plans are submitted for these developable lands it would be advisable that their agricultural capability be given close scrutiny. Ideally, the lands with the highest capability for agriculture should be retained for agricultural uses while the lower-capability lands be allocated for accommodating urban expansion. Low-capability lands could be assigned planning precedence over other lands to foster more-suitable growth. However, it is important to realize that, once the necessary sewer capacity and infrastructure is in place, advocating the cessation of the development process is not realistic.

Contiguity Factor

It is also important when channelling urban growth, to consider the factor of geographic location and proximity to existing development. Land parcels which are of high agricultural capability yet completely encircled by urban areas may be impractical to preserve because of their fragmentation, minute size, and minimal agricultural yield. In order to have contiguity of development, it may be necessary to allow urban development on such high agricultural capability pockets of land rather than encourage linear developments. The key to preserving agricultural land capability is to isolate contiguous land having the highest agricultural capability, located on the periphery of the urban area, and still in agricultural use. These are the lands which should not be permitted to be fragmented or to experience piecemeal land-use changes, but which should be retained for agricultural activities.

Changes in Land-Use Activities

"Changes from productive uses, such as agriculture and forestry, to consumptive uses, such as urban development are essentially irreversible." (Soil Conservation Society of America, 1978)

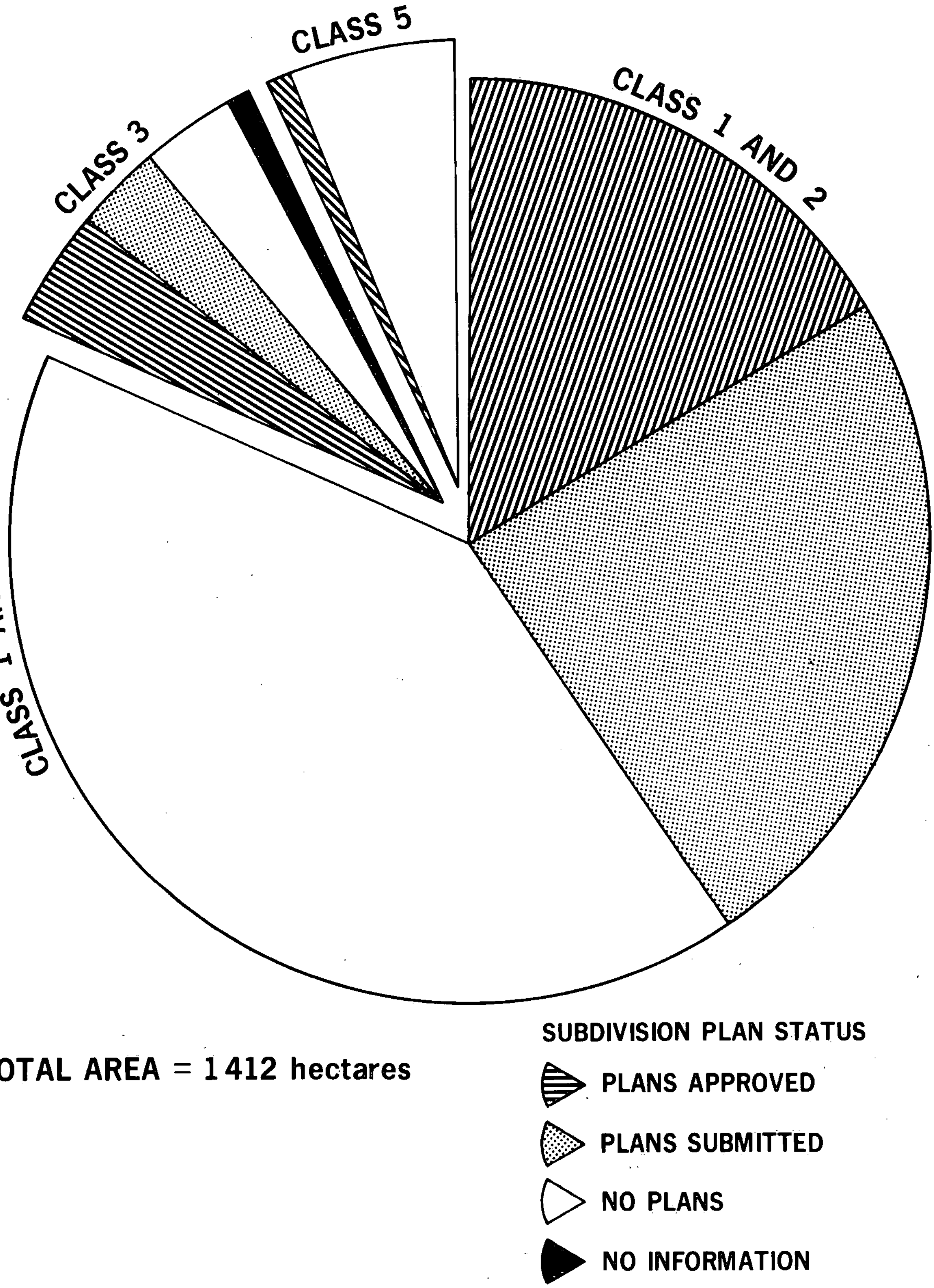
The type of land-use activities which are under urban pressure in the Windsor area are derived by examining the lands with sewers that have subdivision plans approved or submitted in terms of their land use in 1972.

Over 60 percent of the land now in current development was previously cropland (Figure 4). This conversion, along with the use of productive woodland, orchards and vineyards, and outdoor recreation, highlights land activities inappropriately converted to urban expansion. On the other hand, of the use of lands within the built-up sphere, non productive woodland and unimproved pasture can be designated as appropriate uses to consider for conversion to urban functions. Unfortunately, these latter uses compose the smaller proportion of lands under pressure for urban development.

Within the Built-Up Area

A closer examination of the built-up area shown in Figure 4 sheds some light on the quality of land being selected. Of the total built-up area of 211 hectares, 82 percent is of Class 1 or 2 agricultural capability, 17 percent is Class 3, and only one percent is Class 5. Because this land is already in an area classified as urban built-up, the fact that it is of high agricultural capability is not as significant a factor.

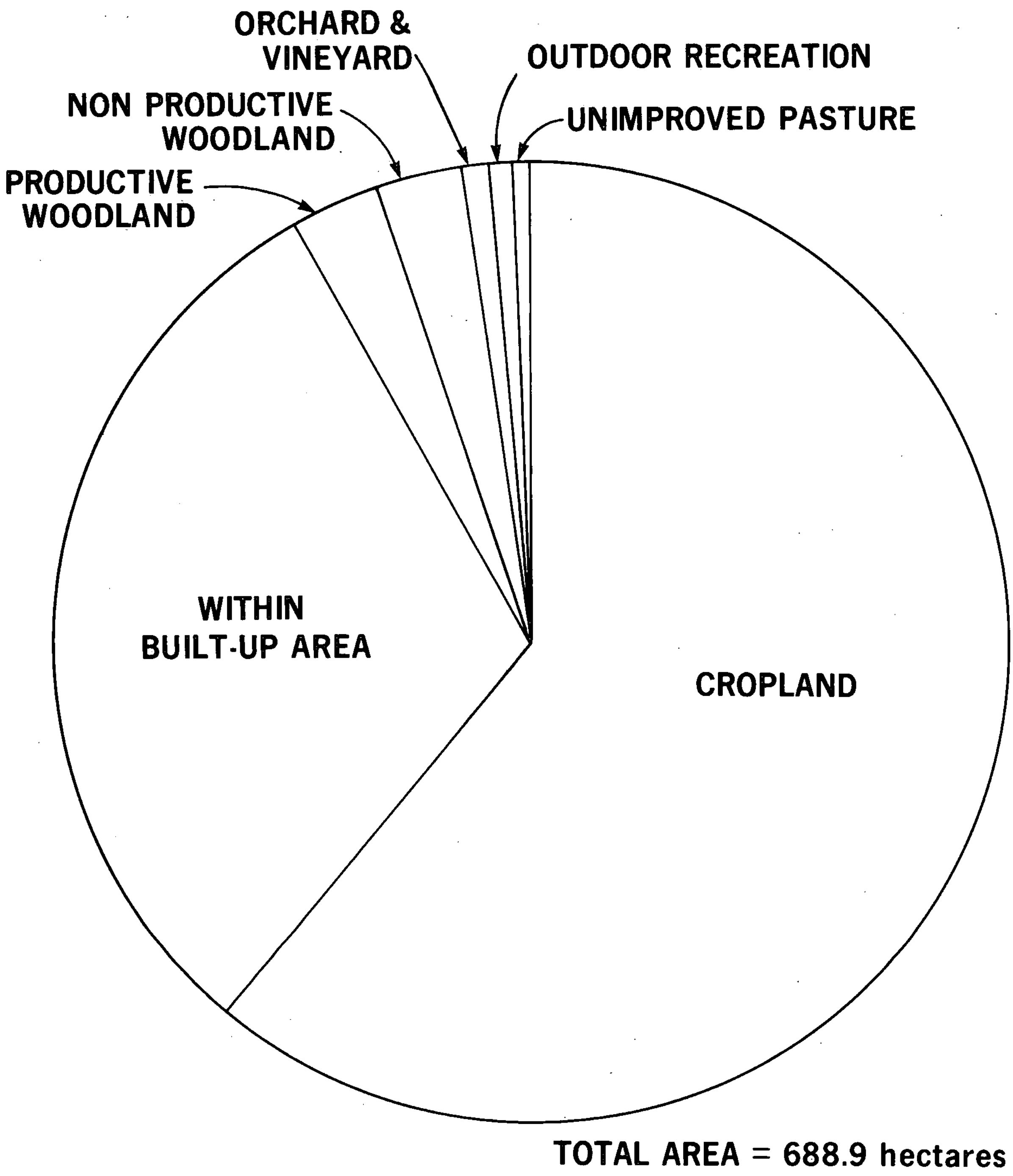
Figure 3. Current Development, Its Agricultural Land Capability and Subdivision Plan Status*



TOTAL AREA = 1412 hectares

*Percentage of Private and Public Developable Lands with available sewers (on or close) in relation to agricultural land capability and plan status.

Figure 4. Land Uses Now Undergoing Current Development*



*Percentage of Private and Public Developable Lands with sewers (on or close) and subdivision plans approved or submitted in terms of their land use.

The use of such land for development is reasonable in that it is located within the boundary of an area already built-up and is not encroaching on peripheral cropland as indicated on Map 9.

Land Classified as Cropland

Similarly, there are 423 hectares of cropland that have been or are about to be intruded upon by urban development. Some 82 percent of these lands are of Class 1 or 2 agricultural land capability. The concern centres on the fact that not only were these lands actively being cropped in 1972 but also that they are of high agricultural land capability. This land is clearly about to be converted, as the subdivision plans are approved or submitted, and has sewers available. The loss of croplands to development is the essence of the problem.

Ideally, services should be planned with close cognizance of land capability, present land use, and contiguity in mind. Once the services are in place, it is merely a matter of time for the planning process to approve the actual construction phase, and for the irreversible conversion of land from rural to urban to be completed. In the upcoming sections, options to alleviate this problem are explored.

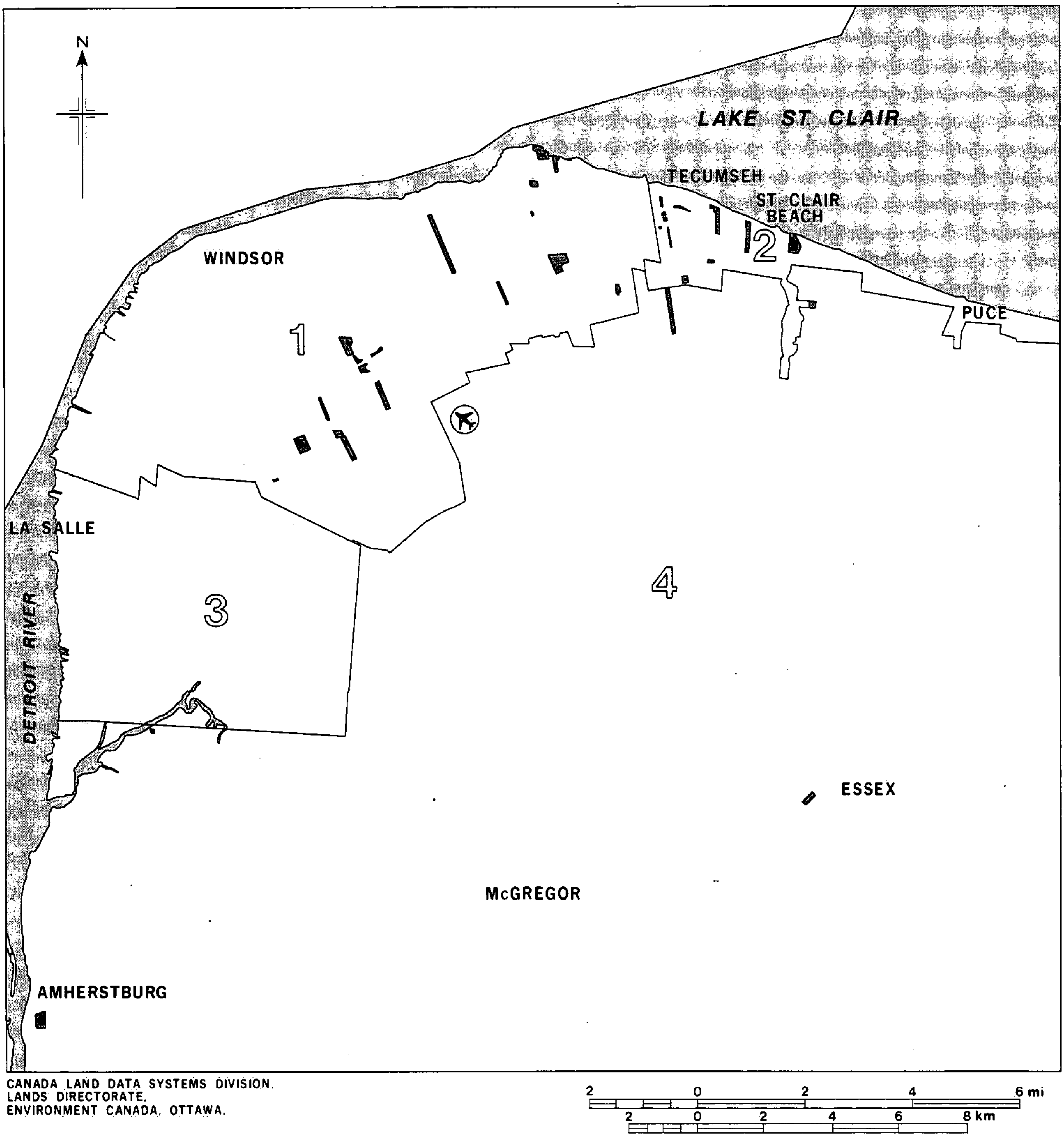
Planning Options

To begin to see where effective planning options still remain and where urban expansion can be funnelled to lower-quality lands, the steps outlined in the previous section must be repeated but with one important difference. The investigation focusses on developable lands but examines the lands where the infrastructure associated with sewers is only at the planning stage in order to reveal planning options. There is a crucial dichotomy between expensive infrastructure in place, and funds already expended, versus planning studies and proposed sewers. It is now necessary to investigate those lands for which development is proposed.

Proposed Development

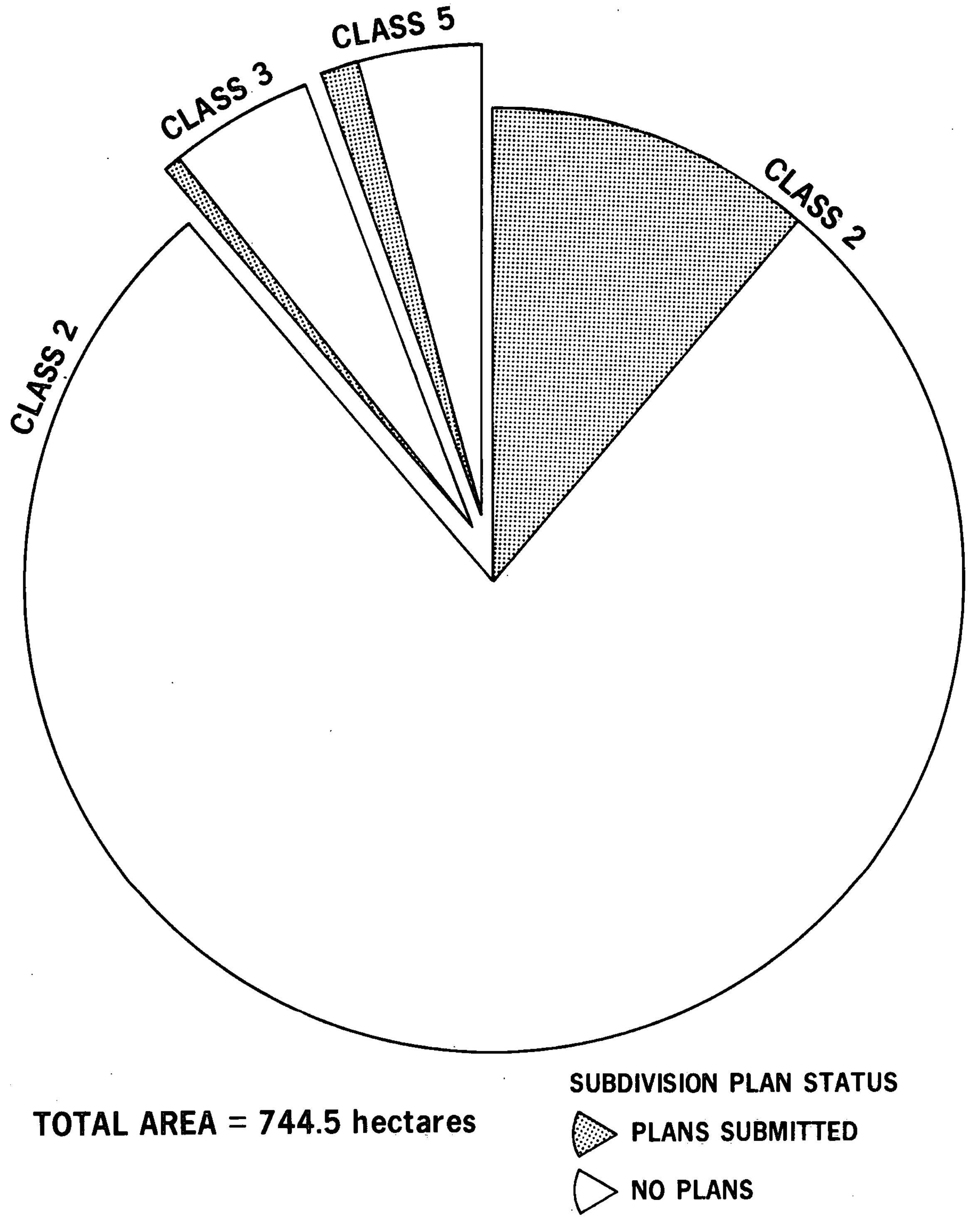
Of the land planned for sewers, 95 percent is land of Class 2 or 3 agricultural quality (Figure 5). The amount of good-quality agricultural land proposed for development is initially disturbing, however, it is important to reflect back on the overall land quality distribution in the Windsor study area. Table 1 (presented in Chapter 1) showed that the proportion of Class 1, 2, or 3 land is 95 percent of the study land area. Thus the sewer planning reflects the agricultural land quality distribution. What it does not

MAP 9. CURRENT DEVELOPMENT USING LANDS WITHIN THE URBAN BUILT-UP AREA.



DEVELOPABLE LANDS WITH SEWERS ON OR CLOSE, SUBDIVISION PLANS APPROVED OR SUBMITTED WITH LAND USE: BUILT-UP

Figure 5. Proposed Development, Its Agricultural Land Capability, and Subdivision Plan Status*



*Percentage of Private and Public Developable Lands with sewers planned, their agricultural capability and plan status.

reflect is an active bias to locate sewers specifically on lands of lower agricultural quality. Proposed sewers could be constructed so as to encourage development on the lower-quality Class 5 and 3 lands.

Subdivision Plan Status

"Unplanned, unregulated subdivision of rural lands may inflate market values to the extent that potential agricultural land is priced out of the market for agricultural uses." (Oldman River Regional Planning Commission, 1979).

In order to see how far along in the planning process are most of the lands with sewers planned, the status of their subdivision plans was investigated. None of these lands have yet received approval of their subdivision plans, although 97 hectares have subdivision plans submitted. By far the majority of these holdings have no subdivision plans. These lands amount to 648 of the 745 hectares which have planned sewers.

Pending Changes in Land-Use Activities

The type of land-use activities on those lands which have sewers planned indicates the type of land-use conflicts that are pending if the proposed sewers are constructed. The proportional pie diagram (Figure 6) illustrates the land uses in 1972. The planned sewers are predominantly on cropland (80 percent), another eight percent are on productive woodland, and only about one percent is on marsh, outdoor recreation, and orchard and vineyard combined. Only about 10 percent of the sewers are appropriately planned within the built-up sphere or to use unimproved pasture (Map 10).

Notice the location of the high-quality agriculture lands which are proposed for sewers on Map 11. They are all on the periphery, clearly not within the present built-up area. In particular, observe the development at the town of McGregor; this is a pocket of land planned for development, physically separate from Windsor, and on Class 2 agricultural land. Such development may be just the beginning of significant encroachment onto the best agricultural lands surrounding this pocket of proposed development. The urban node, if developed, will require services, roads, commercial activities, and open space and will spawn industrial activities all of which will be consumers of more prime land. Development could expand and overflow onto surrounding land and, by its very location, lead to continued consumption of agricultural lands in the future. It is therefore important to understand the implications if limitations are not placed on any further development of the surrounding land area. These are the types of land where agricultural land capability should be closely scrutinized before and

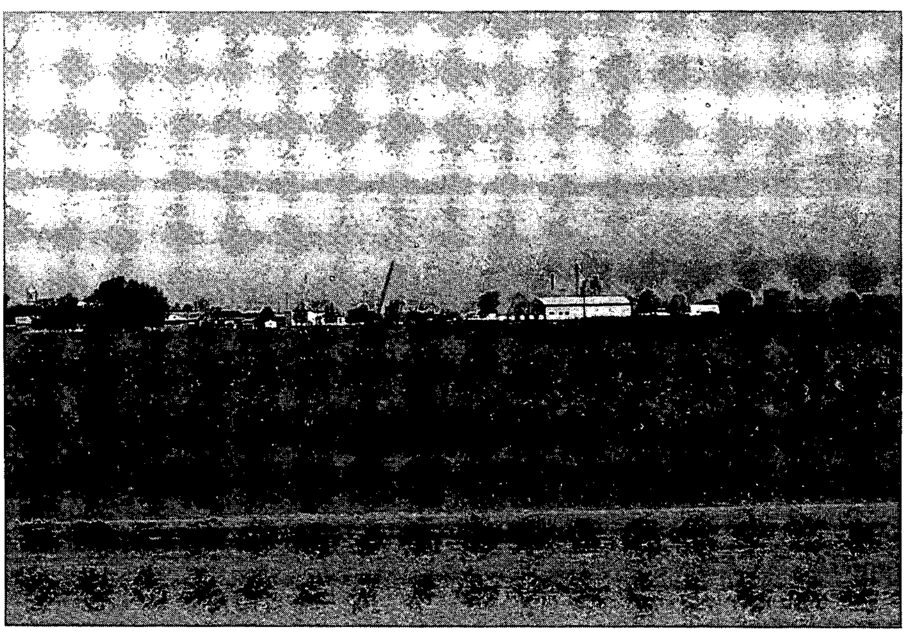
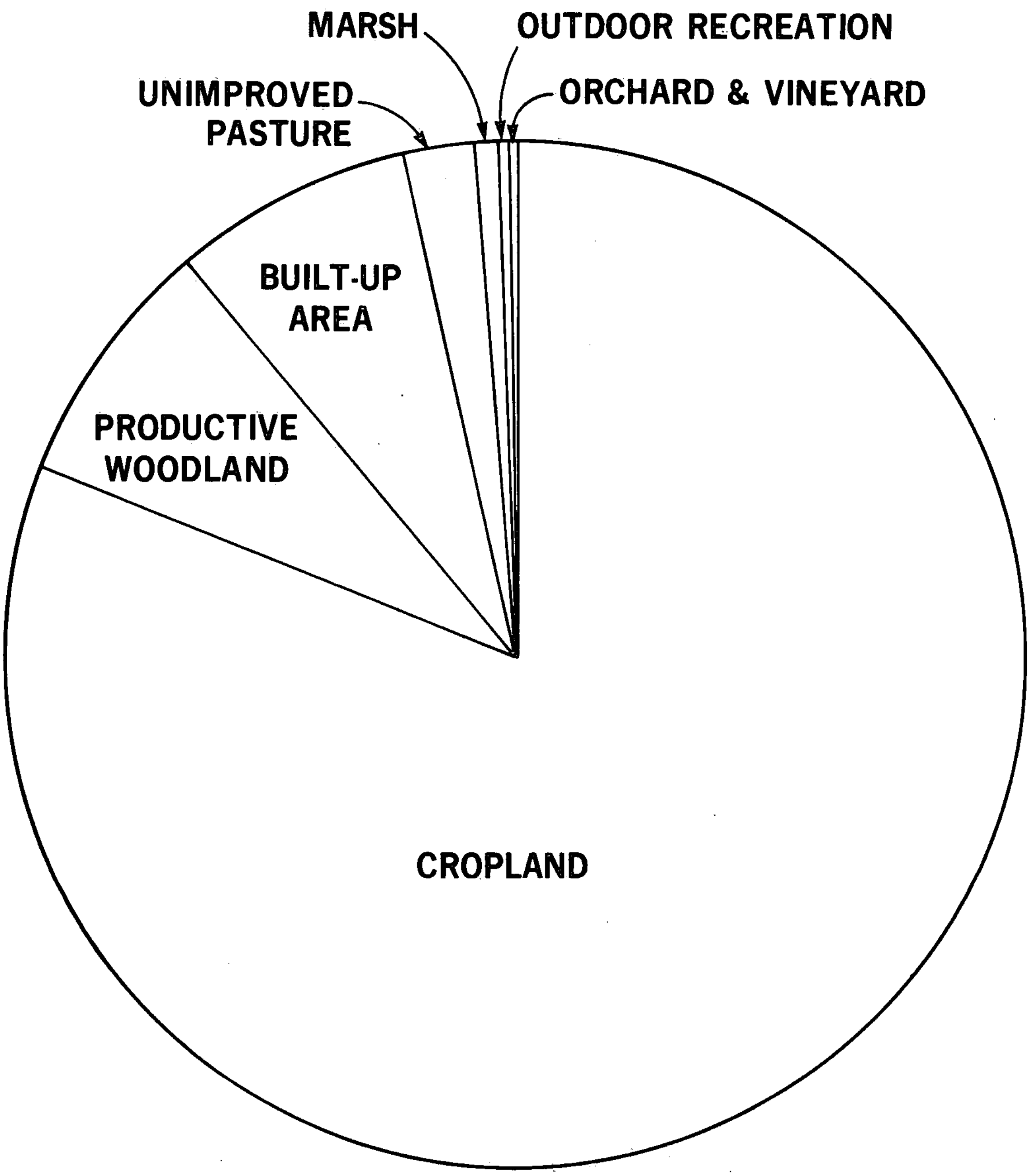


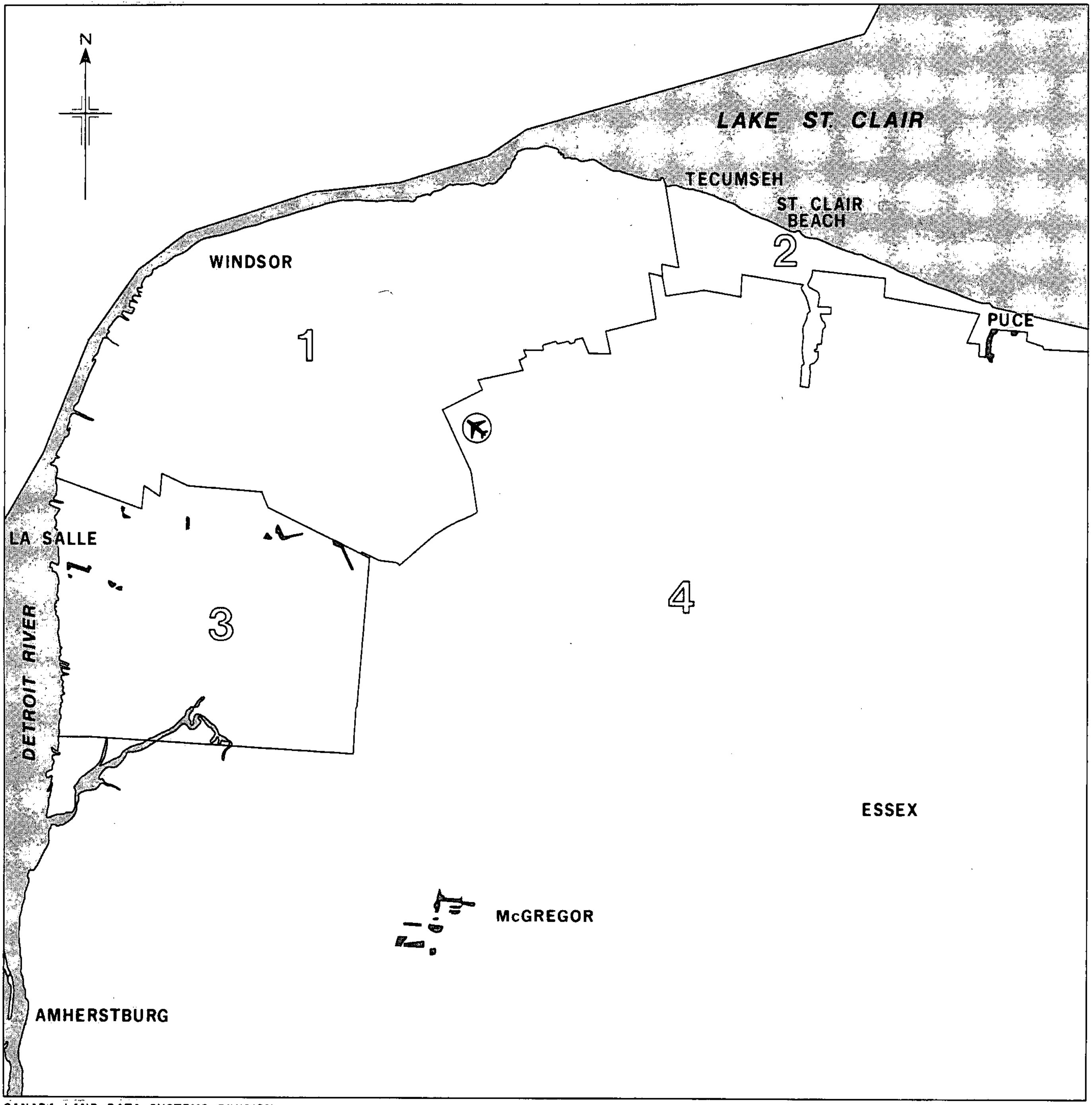
Figure 6. Proposed Development and the Land Use Activities it Affects*



TOTAL AREA = 744.5 hectares

*Percentage of Private and Public Developable Lands with sewers planned, subdivision plans submitted or none in terms of their land use.

MAP 10 APPROPRIATE AREAS FOR PROPOSED DEVELOPMENT.



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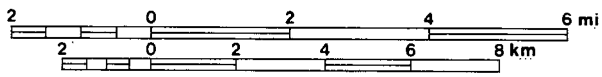
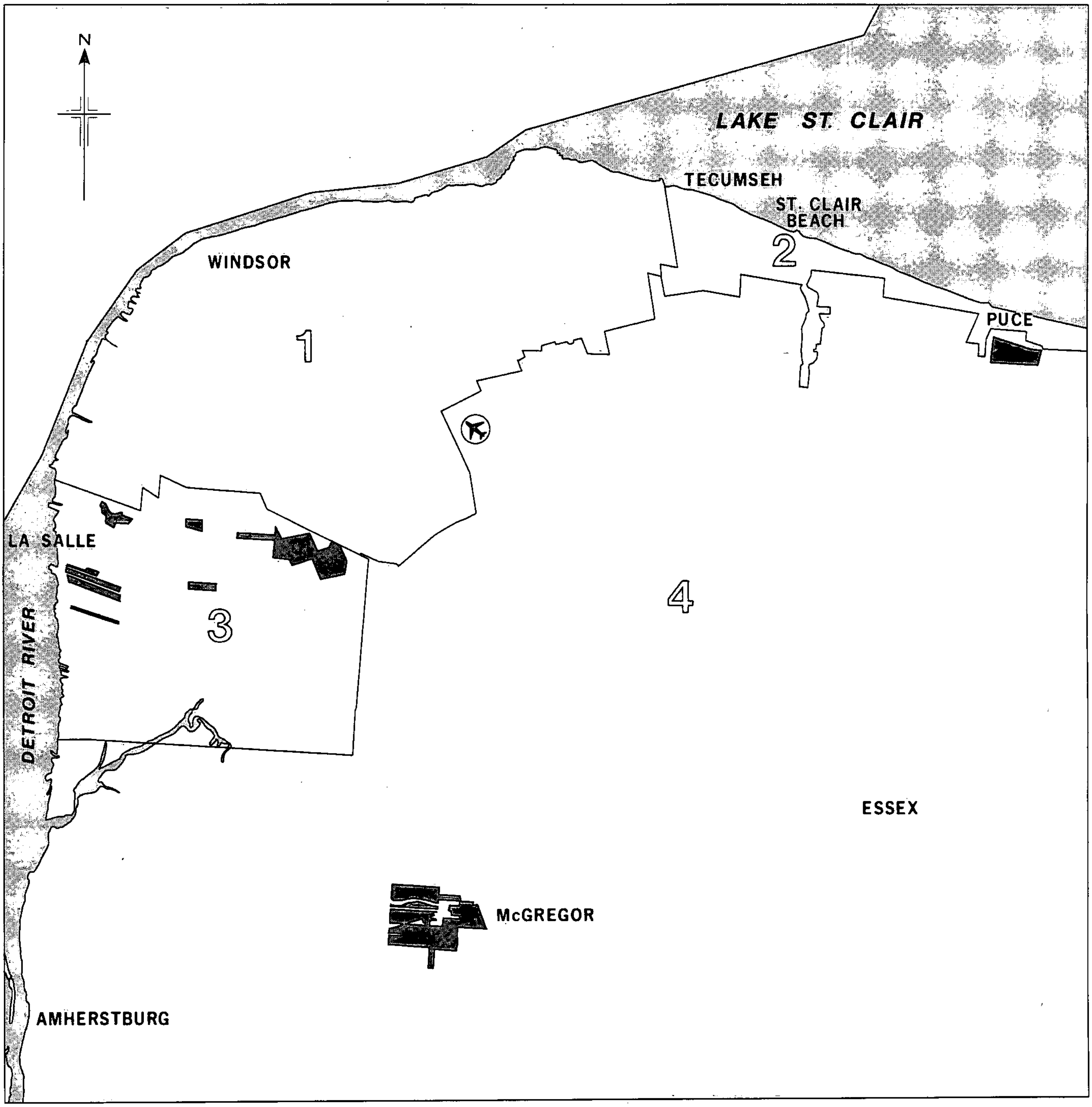


DEVELOPABLE LANDS WITH SEWERS PLANNED AND SUBDIVISION PLANS SUBMITTED OR NONE WITH LAND USE URBAN BUILT-UP OR UNIMPROVED PASTURE.

MAP 11. INAPPROPRIATE AREAS FOR PROPOSED DEVELOPMENT.



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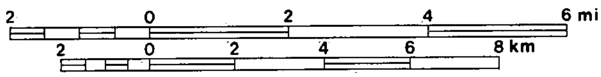


CLASS 2 AGRICULTURAL LANDS WITH SEWERS PLANNED.

during the period in which infrastructure investments are proposed and planned.

Of the other land blocks displayed on Map 11, all are outside the boundary of the urban built-up area which suggests that future development is being directed towards those peripheral areas to the east and southwest of the Windsor metropolitan region. These are prime agricultural areas of Class 2 land and could be maintained and preserved for agricultural purposes.

Held for Development

To complete this part of the analysis, it is necessary to examine those lands that are private and publicly developable but where the important infrastructure investment in sewers is totally absent. These lands are being held for development in anticipation of infrastructure development, for speculative purposes, or for intended lower-density, large-lot, well-and-septic type of development. This list covers a wide spectrum of possibilities and no single holding can be differentiated or evaluated as to its type from the information directly available to this study. A pie diagram (Figure 7), is constructed to note the agricultural land classification and the planning status. There are in total 2,431 hectares of these lands without sewers of which 82 percent of these land holdings are on Class 1 or 2 agricultural land, 17 percent are Class 3 land and the remaining one percent is divided between Classes 5 and 7. The distribution of lands held for development without sewers reflects the natural distribution of agricultural capability. Whereas 95 percent of the total area is agricultural land of either Class 1, 2, or 3, 98 percent of the lands without sewers are of this same quality. This indicates that the natural market forces are not acting in such manner to foster the development of lands of lower agricultural capability.

Subdivision Plan Status

It is important to see what planning actions have occurred on the lands without sewers which are being held for development. Not surprisingly, none of these lands have yet received approval of their subdivision plans; however 143 hectares of the total 2,430 hectares have plans submitted. Submitted plans are only on Class 1, 2, or 3 lands, but yet over one-half of the Class 1 lands held for development have plans submitted. The absolute amount of Class 1 land is small; but despite that fact it is important that the planning process incorporate land quality criteria in the decision-making process. If any active good-quality farmland is to be preserved, Class 1 lands should be of highest priority. The situation here, is that the better-quality lands have been readily absorbed for residential development.

Possible Repercussions on Land-Use Activities

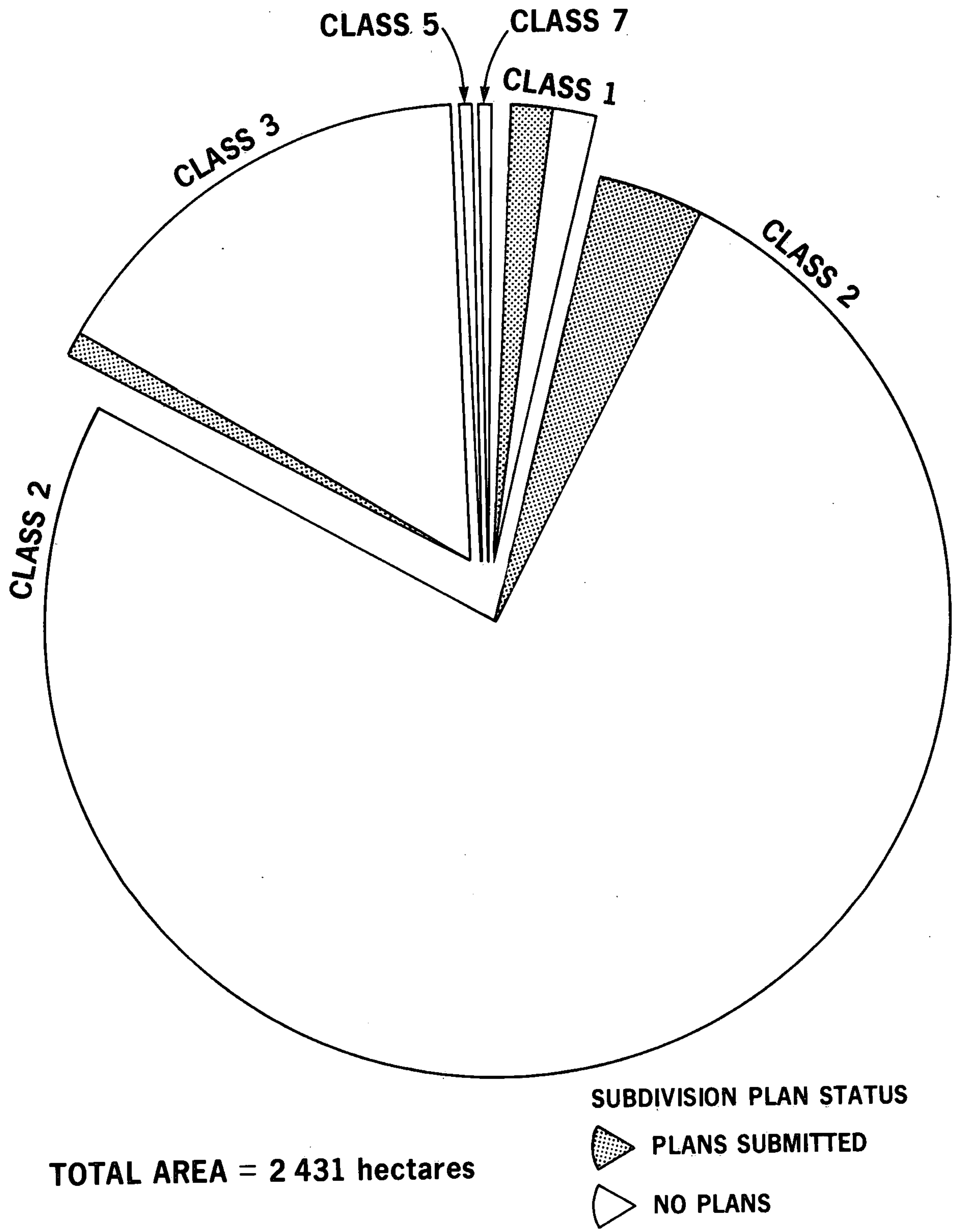
As Figure 8 illustrates, the vast majority (86 percent) of land without sewers held for development was used as cropland in 1972. Another three percent was productive woodland and five percent was used for either outdoor recreation, orchards, unimproved pasture, transportation, non productive woodland, marsh, or extractive activities. Only about six percent of the land holdings are within the built-up area of the city.

As a result, any eventual servicing for development will provoke the same conflict between agricultural and urban uses as currently exists in those areas where sewers are proposed or existing. Should services be extended to these areas, pressures for development rise, and with them land values.

Those parcels already held by developers, which may be leased for agricultural exploitation, may be built upon and farmers will be encouraged to sell their land to developers as prices rise. As a result much agricultural land may be removed from production and left idle for many years before actual development occurs.

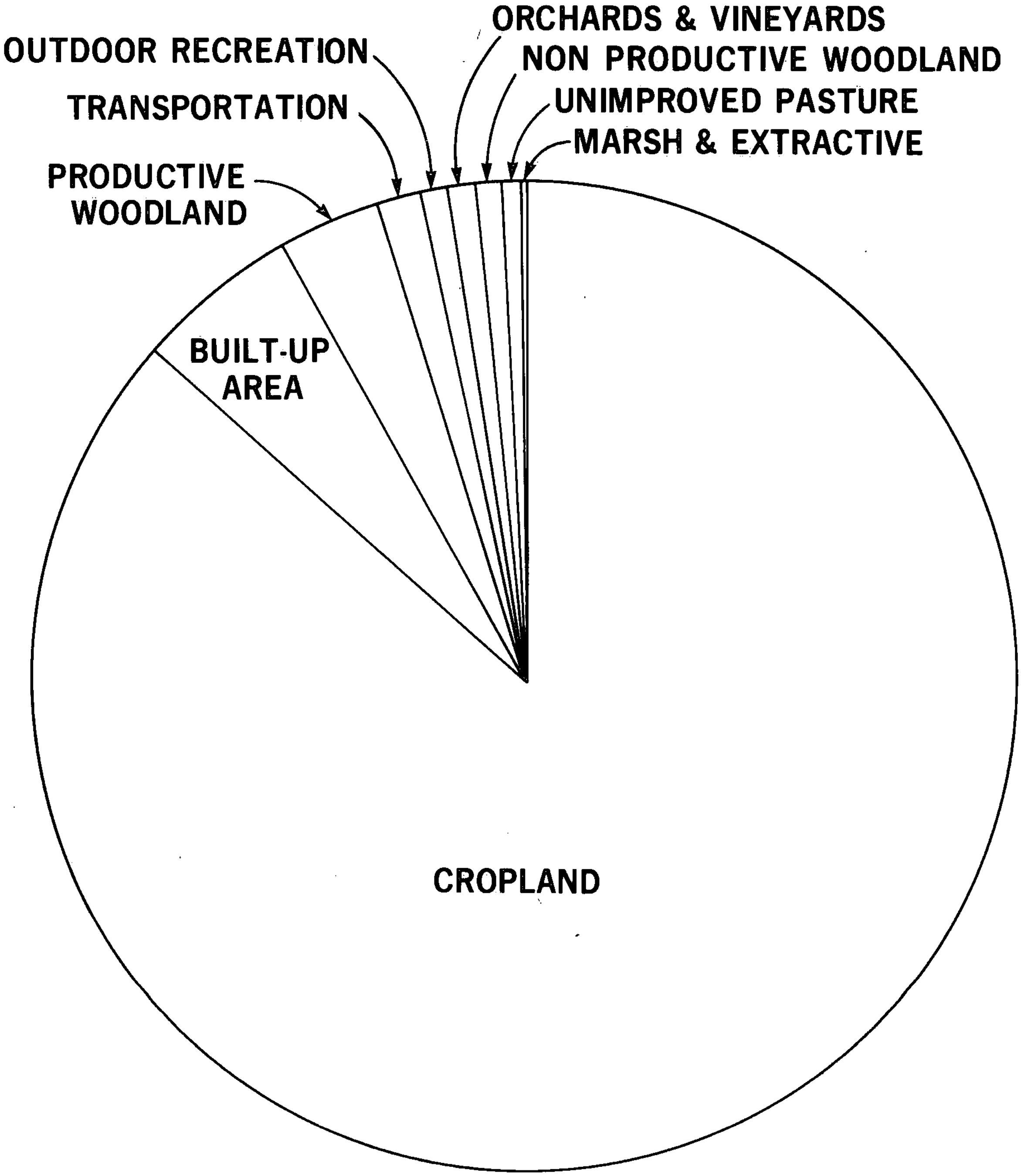
Without resource-based land-use planning on the periphery of urban areas, this process will continue unchecked, and without consideration for the agricultural potential of such land. The shape which a city will assume is based on a complex interplay between market and social planning precepts. Some balance between the two is usually a justifiable and desirable result. By comparing the existing development trends with the optimal development model elaborated on in Chapter 3, it is possible to outline certain guidelines which would contribute to the land resource being used congruently with its natural capacity and capability.

Figure 7. Land Held for Development, Its Agricultural Capability and Subdivision Plan Status*



*Percentage of Private and Public Developable Lands with no sewers in terms of their agricultural class and plan status.

Figure 8. Land Held for Development and the Affected Land Uses*



TOTAL AREA = 2 431 hectares

*Percentage of Private and Public Developable Lands with no sewers in terms of their land use.


St. Clair Beach
SHOPPING CENTRE
TO BE ERECTED ON THIS SITE
PHASE 1
40,000 ft² SUPERMARKET
25,000 ft² RETAIL STORES
PHASE 2
165,000 ft² COMBINING ENCLOSED
MALL, RETAIL STORES & DEPARTMENT STORE
PARKING FOR 1050 CARS
CONTACT
LANDAWN SHOPPING CENTRES LTD.
557 CHURCH ST. TORONTO
(416)
922-2311

CHOICES IN PERSPECTIVE: TOWARDS A STRATEGY FOR DEVELOPMENT

In the earlier discussion of actual development, three stages of development were identified (current, proposed for, and held for development) the agricultural capability of the lands in each of those stages was indicated. In this chapter, the actual development pattern in Windsor is compared to the optimal development model. Such a comparison shows where development is occurring and where, ideally based on agricultural capability, it could be channelled. This approach allows an assessment of the actual development pattern. Following the examination of the actual and optimal development patterns, viable alternatives and options can be formulated to preserve high-capability agricultural lands. In the long term, it may be possible to recognize and preserve lands of superior agricultural capability.

When those lands actually being developed (private and public developable) are identified in relation to the optimal model, a large discrepency between the two, results. Only 72 hectares of actual development lands are within the areas identified by the optimal development model, 11 hectares in Sector 1 and 61 hectares in Sector 3. This amount of land is inadequate to supply Windsor's annual growth requirements of 125 hectares. Therefore the criteria used to construct the optimal development model must be closely scrutinized.

Consequently, certain tradeoffs must be made to ensure a sufficient supply of land for housing. For example, such tradeoffs might be to accept development on low-quality agricultural lands, even if these are actually used as cropland, or to permit development on lands which present certain constraints to building, such as adverse topography although this may imply increased costs, or to permit development on good agricultural land only if it is contiguous with the existing built-up area.

In order to make such choices, it is essential to evaluate the quantities of land within each category, and to establish the priorities to be accorded to the protection of prime agricultural land.

In the rest of the section the changes in the land supply are examined that occur when the criteria for the optimal development model are modified. Then this land supply is discussed in terms of the three stages of development, with particular emphasis on those lands held for development.

Elimination of Land-Use Variables

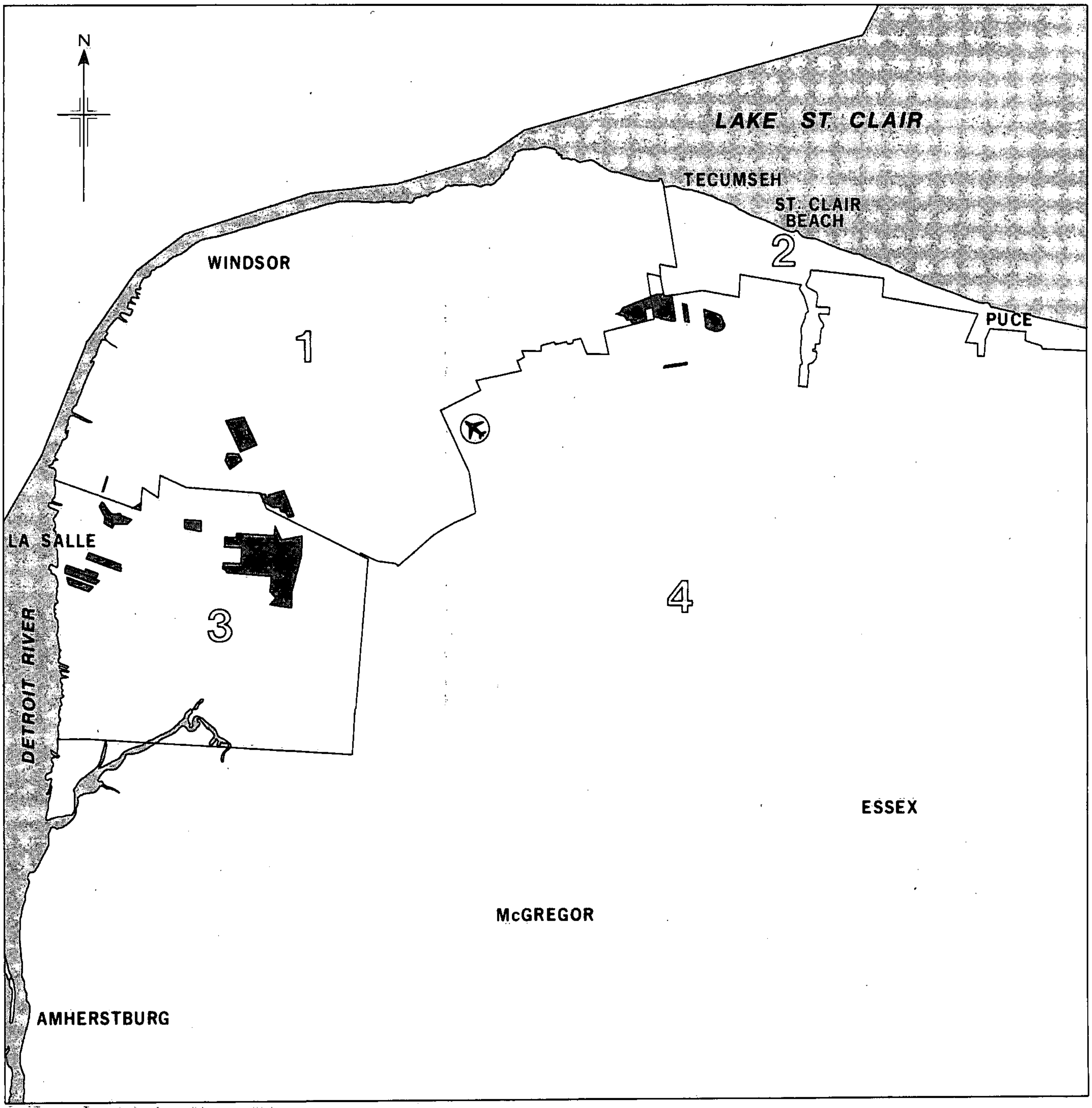
The available land supply can be substantially increased by amending the land-use and agricultural subclass variables. Using the optimal development model but removing all the land-use restrictions, the total developable land supply increases to 613 hectares (Map 12). The pattern shows that Sector 3 dominates with 396 hectares.

This concession includes the two major land uses of cropland (470 hectares) and built-up land (63 hectares). This information indicates that a certain amount of infill within the built-up area is ongoing through the actual development process which is a positive action. However, 78 percent of this supply increase results from using good-quality cropland which is at some point within the three stages of land development. The loss of good-quality cropland to urban development appears to be a phenomenon of some concern in the Windsor area. In future, this type of change in land use should be kept to a minimum, where possible.

Elimination of Agricultural Subclass Variables

To explore viable options other than using good-quality cropland for growth, agricultural subclass limitations were removed from those lands in the development process. However, restricting development on cropland was reintroduced to protect the areas of high-quality cropland. At first, only Class 3 through 7 agricultural capability lands were tabulated and this resulted in a total of 193 hectares of land supply for growth. Since the annual growth requirement for Windsor is 125 hectares, this is insufficient land for even short-term planning.

MAP 12. DEVELOPABLE LAND HOLDINGS WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN REMOVING LAND USE RESTRICTIONS.



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AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7 EXCLUDING SUBCLASSES INUNDATION TO STREAMS OR LAKES, SHALLOWNESS TO BEDROCK, ADVERSE TOPOGRAPHY AND EXCESS WATER WITH NO LAND USE RESTRICTIONS WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.

TABLE 7. The Developable Land Supply in Relation to the Optimal Development Pattern*

Agricultural Subclasses	Land Area (hectares)	Land Uses+	Land Area (hectares)
Excess Water	736	Marsh	7
Low Fertility	135	Built-Up	580
Inundation by streams or lakes	15	Productive Woodland	165
Shallowness to bedrock	18	Unimproved pasture	39
		Nonproductive Woodland	68
		Transportation	45
Total	904	Total	904

* Agricultural capability Classes 2, 3, 4, 5, 6, and 7 lands.

+ Excluding cropland, pasture, horticulture, outdoor recreation, orchards or vineyards.

Consequently, Class 2 lands other than those used for cropland, pasture, orchards, vineyards, horticulture, or outdoor recreation were introduced into the tabulation. The results proved that much of the land initially considered to be inappropriate for housing development by agricultural subclass definition, is actually being held by developers. The agricultural subclass breakdown of the total land supply shows that the vast majority of developable land is subclass W denoting an excess of water. This phenomenon infers that while this subclass impedes construction, it is not a determining feature for developers in the Windsor area. Similarly, the other subclasses eliminated by the optimal development model, such as shallowness to bedrock and inundation by streams or lakes, appear not to be deterrents to developers judging by the pattern of land holdings. Therefore, if developers are permitted to develop on this land, a favourable situation results, in that less-favourable farmland is used for residential development.

In overlaying the developable lands with the Class 2 through 7 agricultural capability lands and excluding those land uses already outlined, the result is a fairly large land supply. Map 13 and Table 7 show the distribution of these 904 hectares of land, which amount to a seven-year supply of land for Windsor's growth. In comparison to the total developable land (private and public developable) in Windsor, this is only about 18 percent of total holdings. The reason that most developable land is not selected is because the vast majority of the holdings, 3,847 hectares, are on cropland.

Development Stages in Relation to the Optimal Development Model

If development is, in fact, restricted to the 904 hectares, there are the three stages of development to be considered when evaluating the supply of land. The amount of land available for current, proposed, and held for stages of development must be tabulated.

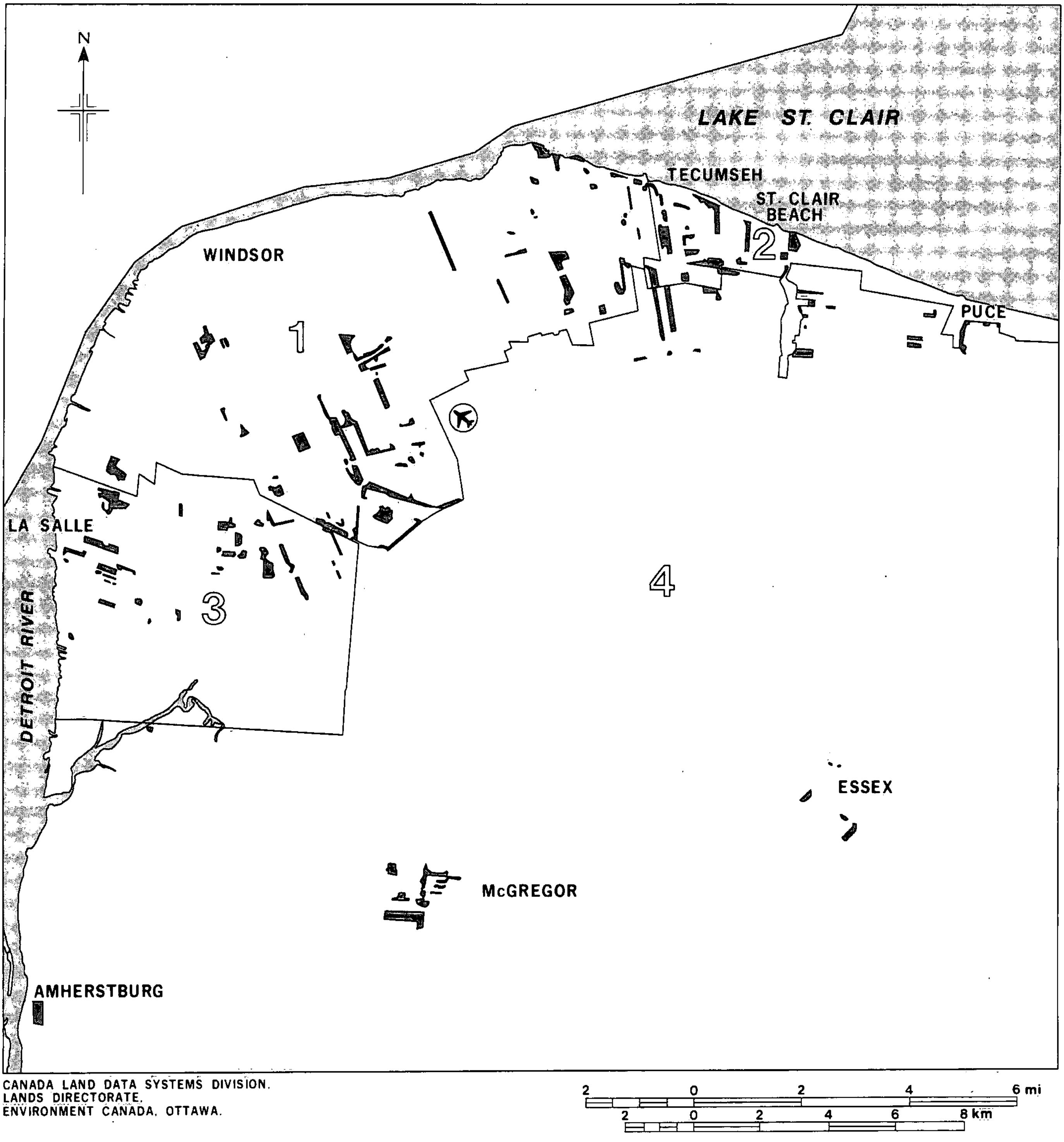
Current Development in Relation to Optimal Development Model

Current development, in respect to the 904 hectares of development, is indicated on Map 14. The total area currently undergoing development is 335 hectares which is sufficient for nearly three years of continued growth. This is clearly adequate to accommodate short-term housing requirements. The pattern of current land development as shown on Map 14 indicates that the land resource is being used wisely as most of the development is contained within the immediate urban built-up area. The pattern suggests that some amount of infill of vacant land is ongoing.

Proposed Development in Relation to Optimal Development Model

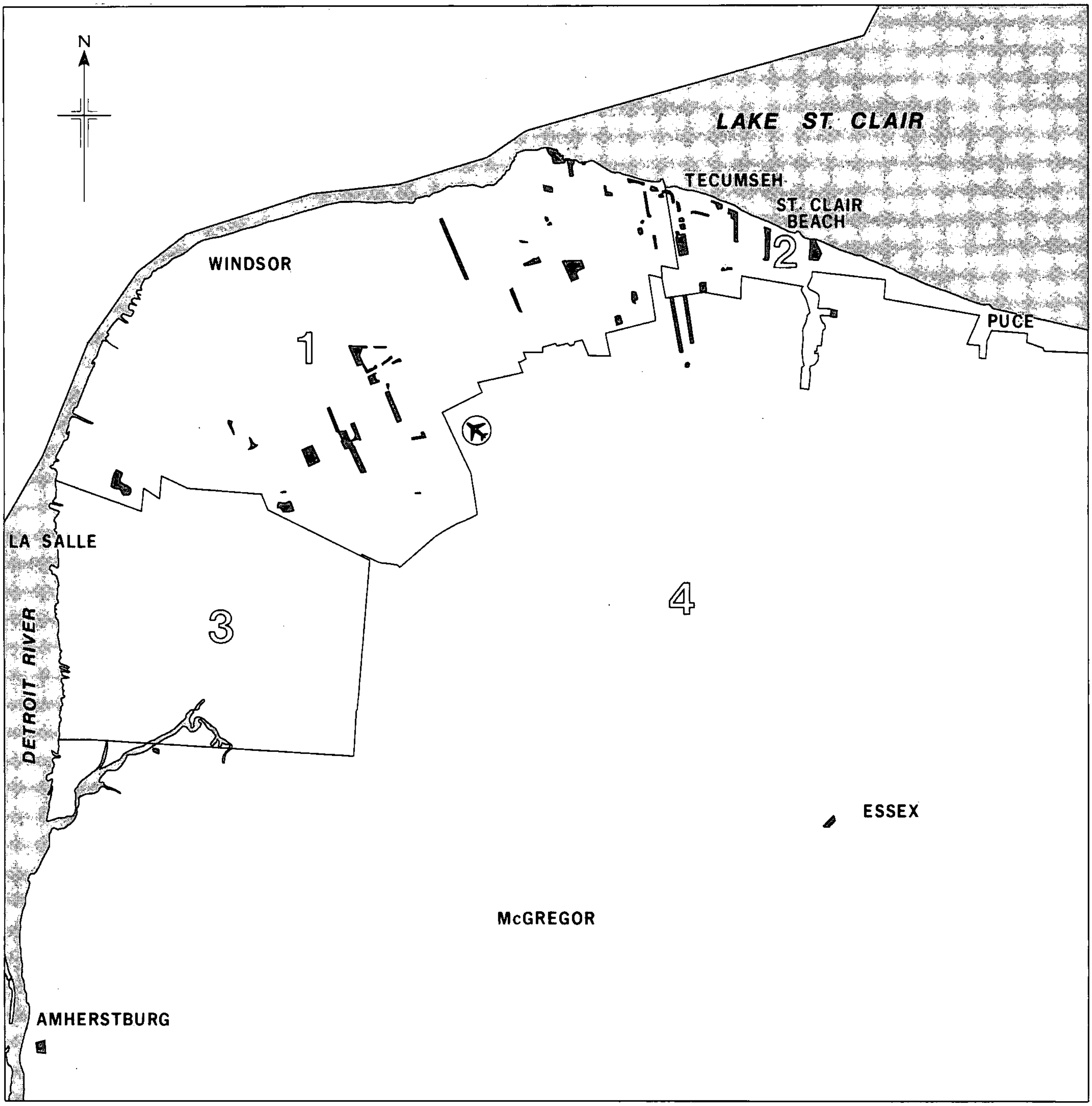
Next, proposed development is tabulated and the results appear on Map 15; the total supply here is only 141 hectares. The spatial pattern indicates that the proposed development is in Sector 3 (61 hectares), with a number of small parcels in Sector 4 (80 hectares) clustered around McGregor. This amount of land will suffice for about one-year's housing

MAP 13. DEVELOPABLE LAND HOLDINGS WHICH COINCIDE WITH THE OPTIMAL MODEL REMOVING AGRICULTURAL SUBCLASS RESTRICTIONS.



AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7, EXCLUDING THE LAND USES OF, CROPLAND, ORCHARDS, VINEYARDS, HORTICULTURE AND OUTDOOR RECREATION WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.

MAP 14. THE CURRENT DEVELOPMENT PATTERN WHICH COINCIDES WITH THE OPTIMAL DEVELOPMENT PATTERN.



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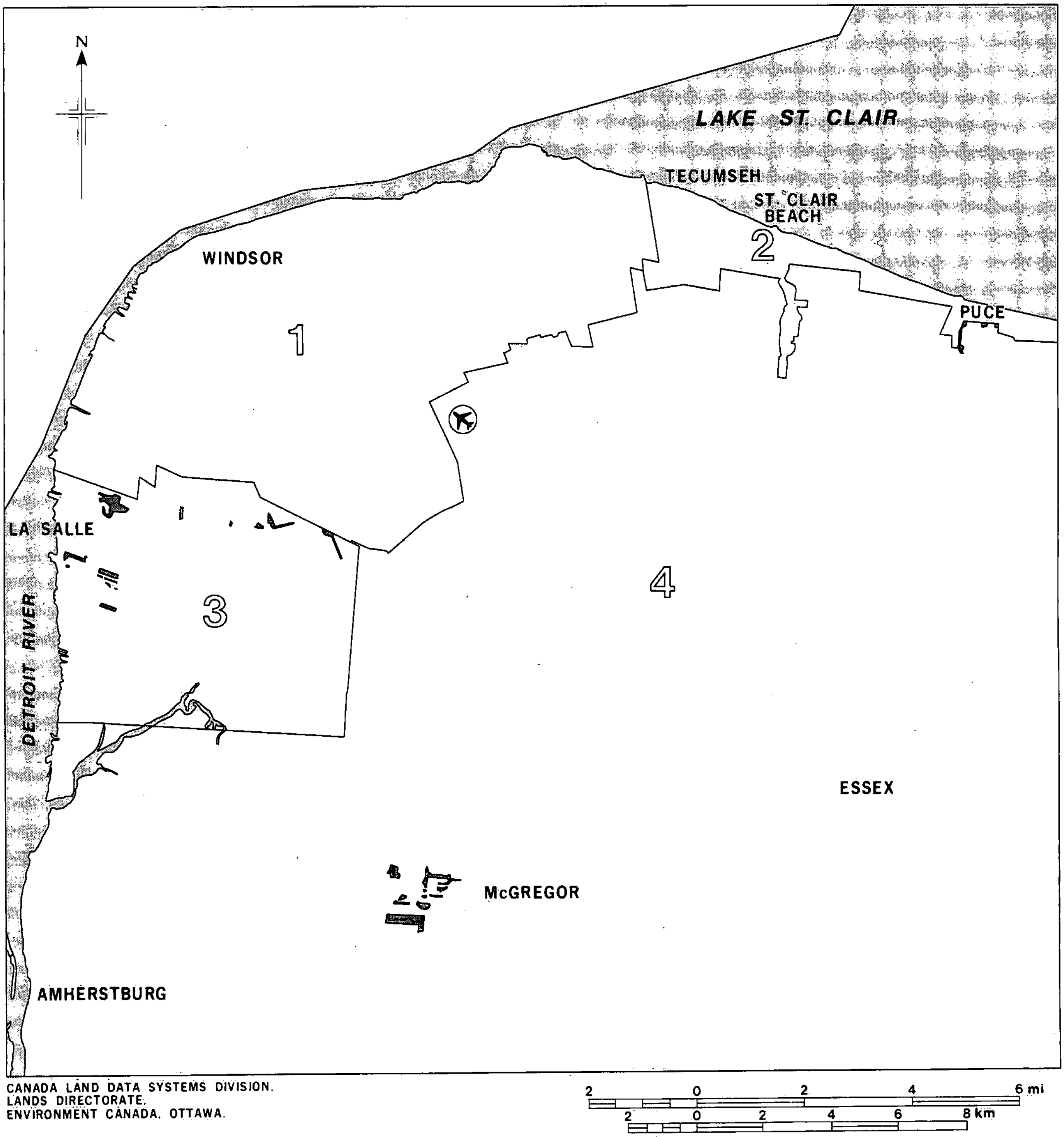
LANDS WITH SEWERS ON OR CLOSE TO THE SITE, OF AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7 EXCLUDING LAND USES OF CROPLAND, ORCHARDS, VINEYARDS, HORTICULTURE, OUTDOOR RECREATION AND PASTURE WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.

MAP 15. LANDS PROPOSED FOR DEVELOPMENT WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.



LANDS WITH SEWERS PLANNED OF AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7 EXCLUDING THE LAND USES OF CROPLAND, HORTICULTURE, VINEYARDS, ORCHARDS, OUTDOOR RECREATION AND PASTURE WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.

needs. When the cropland restriction is removed, a total of 616 hectares is added (Map 16). The majority of this new land supply is of Class 2 agricultural capability and is distributed in large part in Sectors 3 and 4 at Puce and Emeryville, as well as at McGregor. What is of special concern is the potential for expanded development around McGregor. If an urban node develops and grows, it would be associated with all the typical rural/urban land-use conflicts. Its growth would likely lead to the consumption of high-capability cropland and it appears not to be an advisable alternative to pursue.

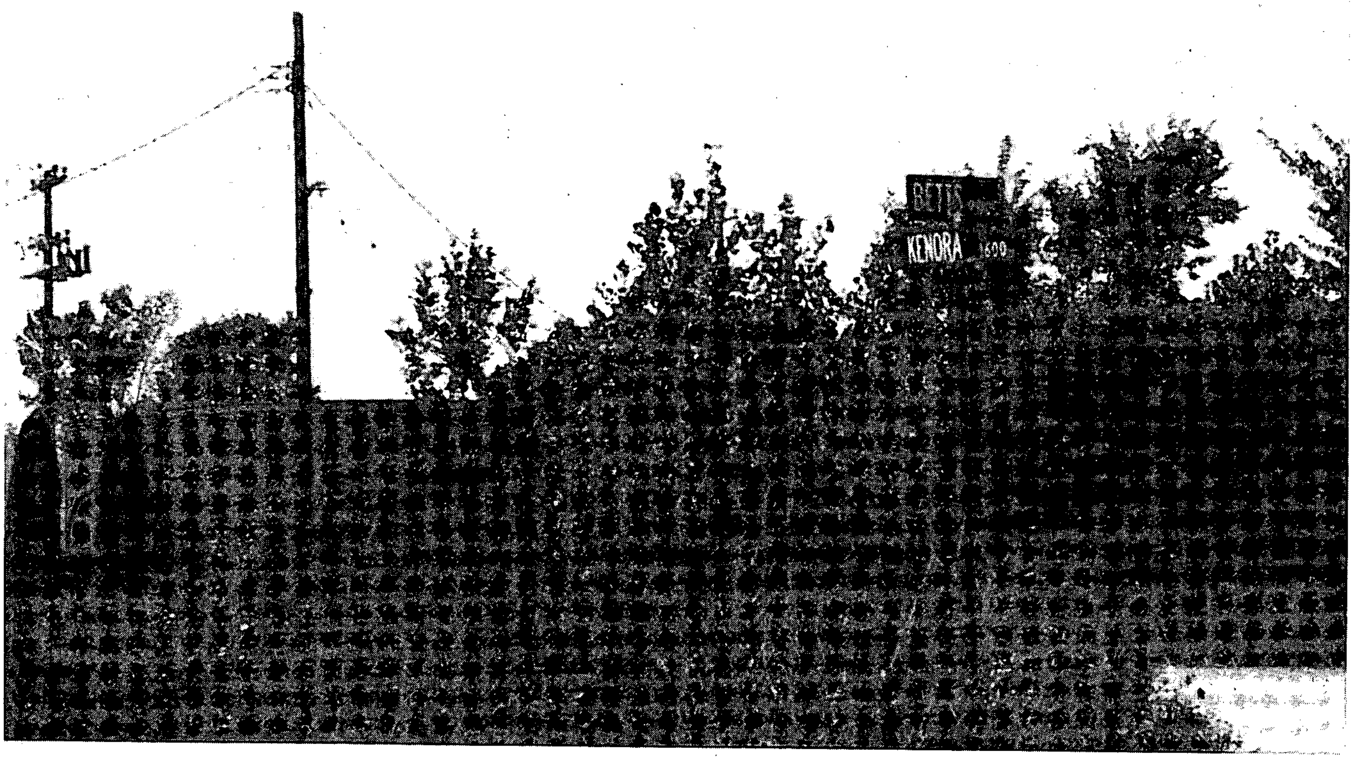
Lands Held for Development in Relation to Optimal Development Model

The lands of greatest concern in terms of future development, are those which have not yet experienced the infrastructure investment of sewers. These are the lands where future development can still be influenced through the planning process at the local level. Of the 904 hectares, 428 hectares are being held for development and these are displayed on Map 17. This land amounts to another three-and-a-half-year land supply for Windsor's growth requirements. These land holdings are scattered throughout the study area, with the majority located in Sector 1 (191 hectares), Sector 2 has 52 hectares, Sector 3 has 103 hectares, and Sector 4 has 82 hectares.

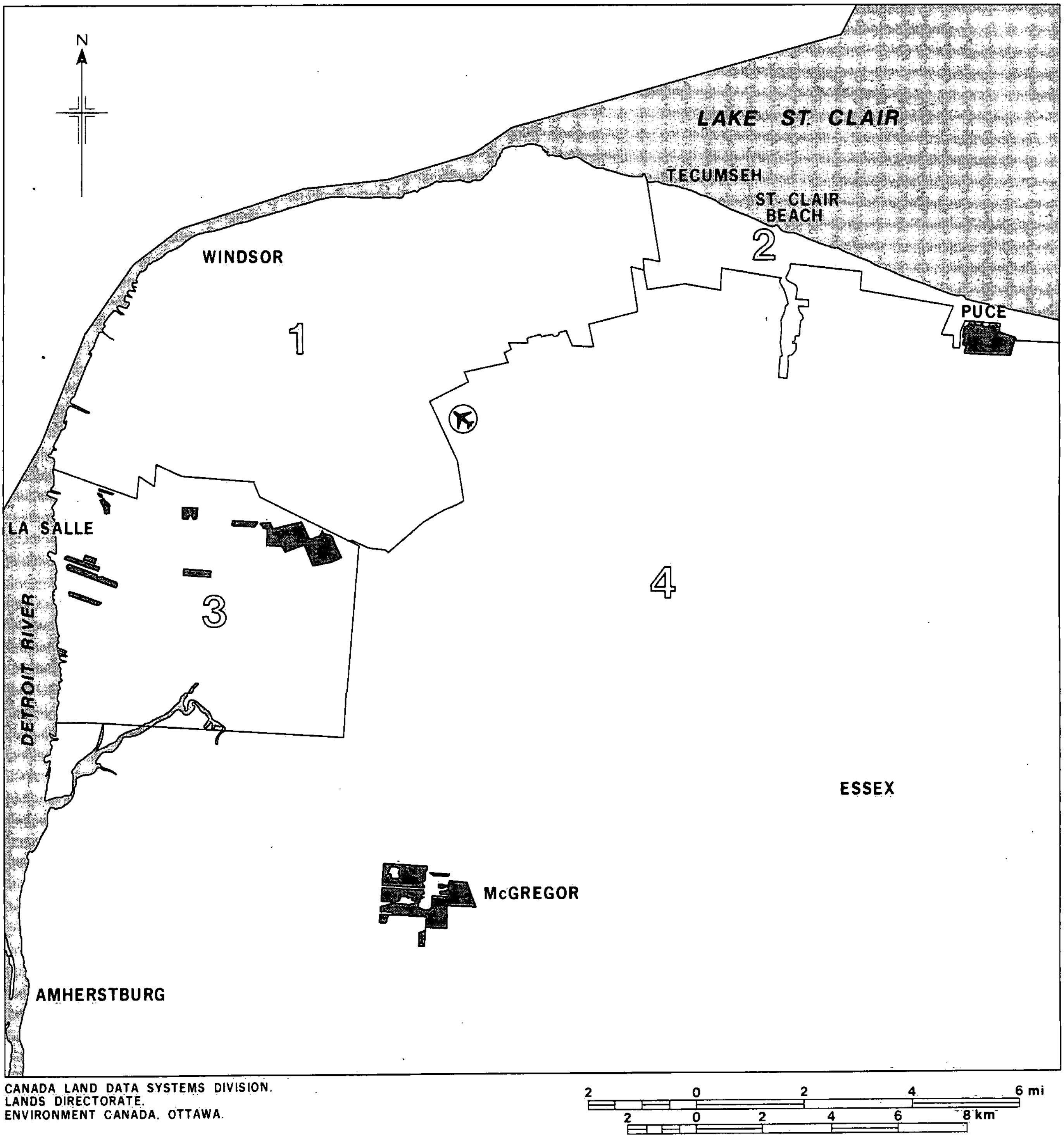
These land holdings are indicative of the areas most suitable for future housing development and hence, where growth could be directed. These land parcels are already owned by various developers and private individuals, are without sewer trunklines on or close to the site, and qualify as lands within the optimal development pattern. Because these lands qualify within the prototype as good areas for urban growth, they should be proposed as areas for sewer installation and subsequent housing development. In future, these are the land parcels where development would then occur.

Priorities for Land Development

In the long term, it is desirable to preserve those lands which have the highest agricultural land capability, namely Classes 1 and 2. Map 18 shows the overall distribution of those parcels without sewers which occur on such lands. These lands which are held for development should be preserved where possible as they have no investment in infrastruc-



MAP 16. PROPOSED DEVELOPMENT INAPPROPRIATELY CHANNELLED ON TO HIGH-QUALITY CROPLAND.



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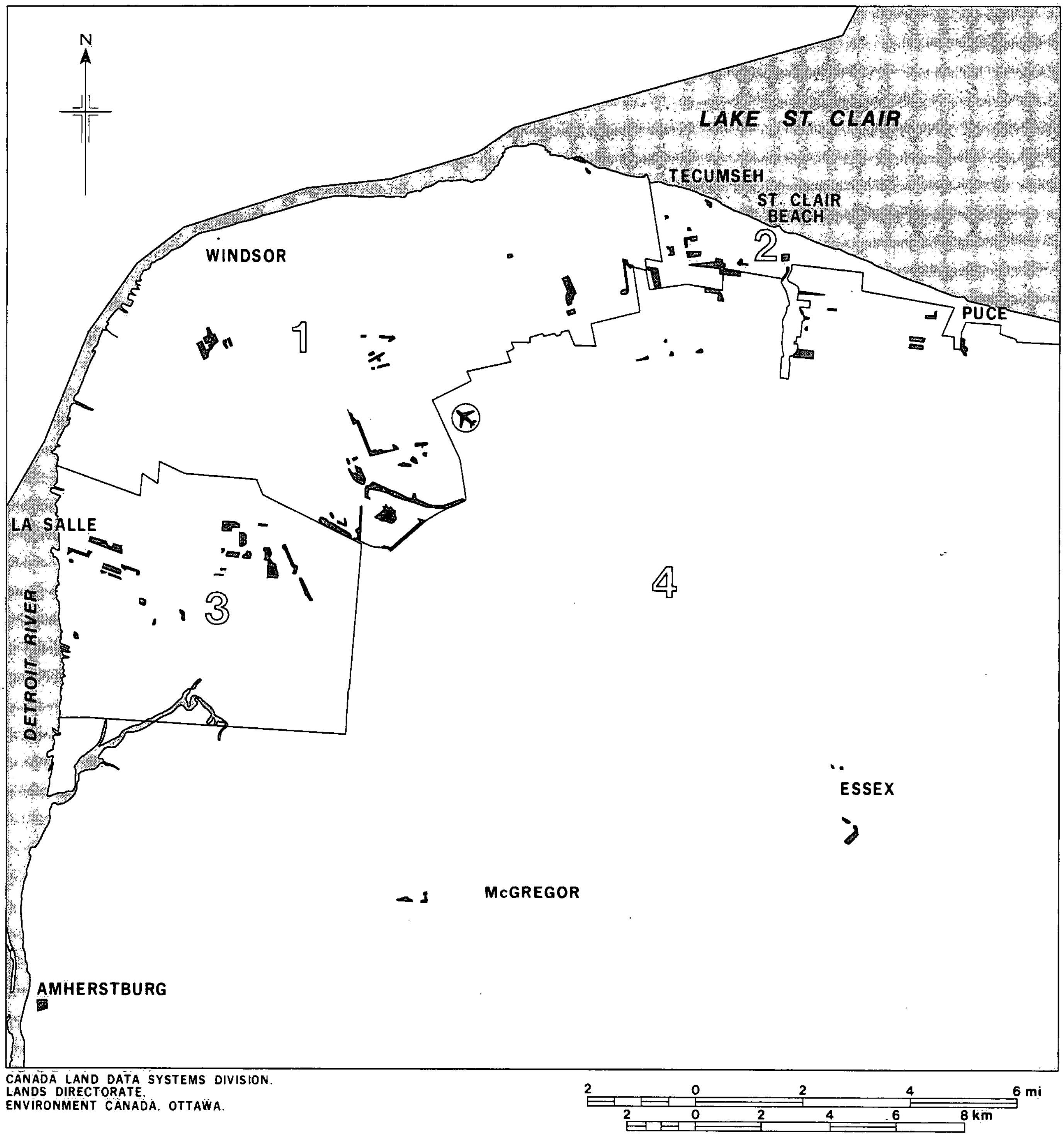
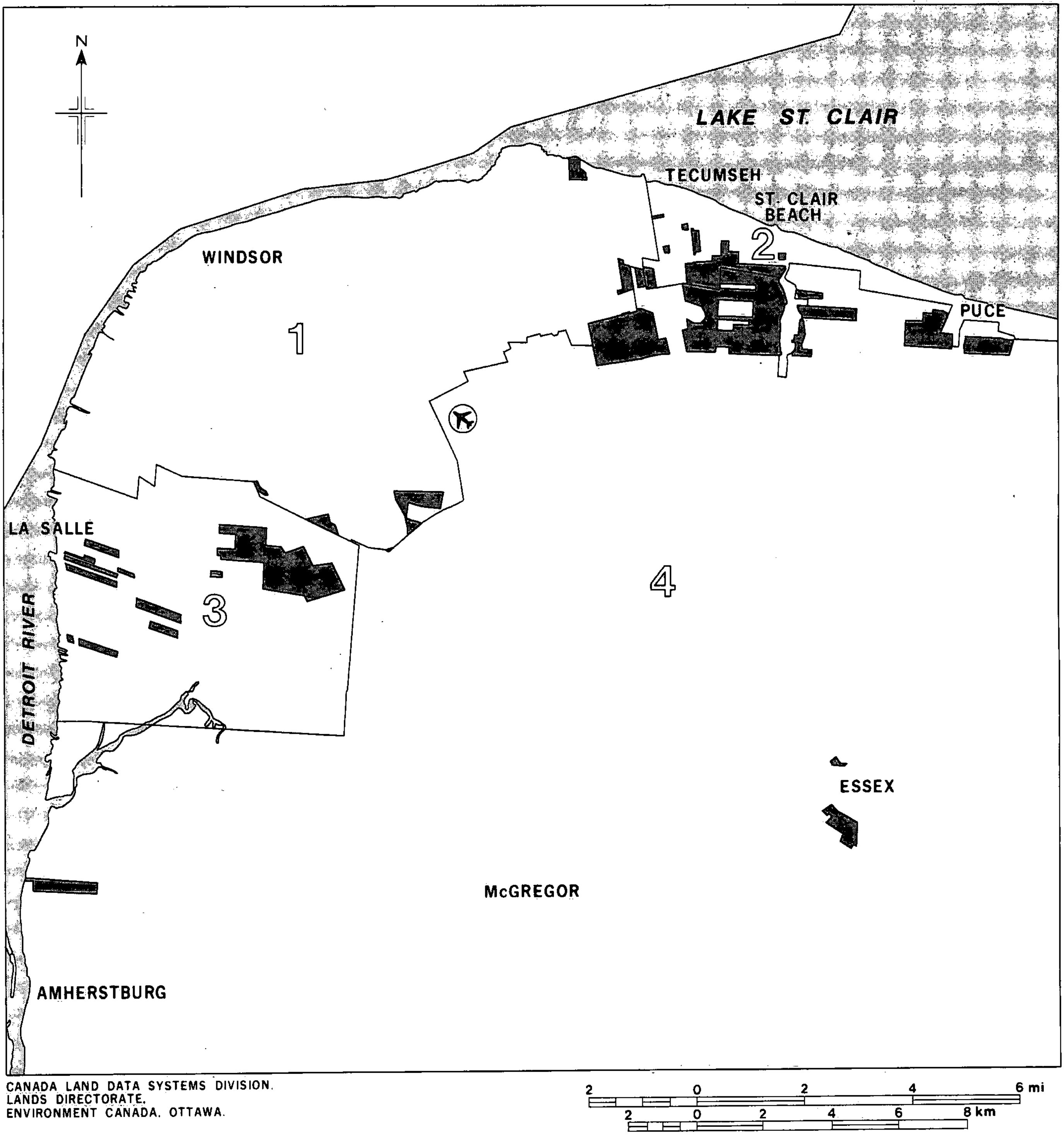
AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7, ON LANDS WITH SEWERS PLANNED AND INCLUDING ONLY THE FOLLOWING LAND USES: CROPLAND AND PASTURE.

MAP 17. LANDS HELD FOR DEVELOPMENT WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.



AGRICULTURAL LAND CAPABILITY CLASSES 2, 3, 4, 5, 6 AND 7, ON LANDS WITHOUT SEWERS AND EXCLUDING THE LAND USES OF CROPLAND, ORCHARDS, VINEYARDS, HORTICULTURE, OUTDOOR RECREATION AND PASTURE WHICH COINCIDE WITH THE OPTIMAL DEVELOPMENT PATTERN.

MAP 18. HIGH-QUALITY AGRICULTURAL LANDS HELD FOR DEVELOPMENT.



CLASS 1 AND 2 AGRICULTURAL CAPABILITY LANDS WITH NO SEWERS AND INCLUDES ALL LAND USES.

ture. Any proposal for the installation of sewers on these lands should be critically evaluated.

On the other hand, those lands which should be considered first for development are the agricultural lands without sewers occupying Classes 3, 5, 6, and 7. These lower-capability lands should be designated first for development purposes. Growth could be directed to these land parcels through planning proposals to construct trunkline sewers and interceptors on them. They could also receive subdivision plan approval before lands with higher agricultural capability. Official plans could consider designating these land parcels as growth areas.

The problem here is one of priorities. Is the preservation of Canada's most productive agricultural lands a higher priority, or is the pressure for urban expansion so great that land development, regardless of its capability, is the greatest priority?

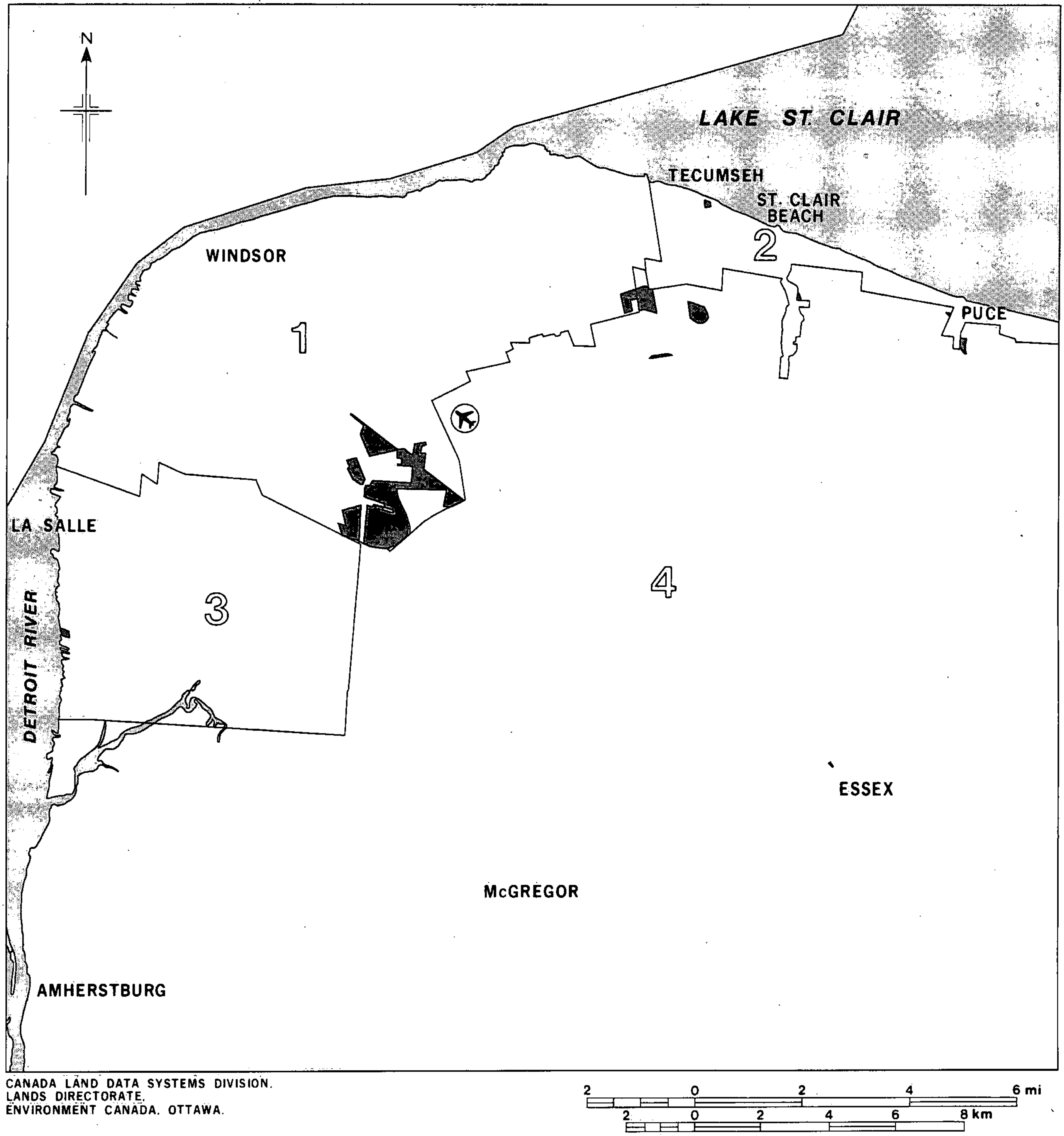
It is important to reach a compromise so that development does not consistently occur on prime agricultural land but rather on the marginal and lower-quality lands. Development costs escalate as the land capability decreases, certainly the least-productive land is often the most expensive to develop. When sewer extensions and construction are planned, marginal lands could be selected thus steering development away from Class 1 and 2 agricultural lands.

Map 19 identifies the land parcels held for development where future growth could be designated, as these are without sewers and are on Class 3, 5, or 7 agricultural lands. To the north, these land parcels are adjacent to developable lands with sewers available and subdivision plans approved or submitted. As well, to the west of this area are land parcels which have sewers planned; thus, the development of these parcels would result in a contiguous growth pattern rather than a patchwork approach with a number of isolated development pockets. The contiguity of available sewers and planned sewers should make extensions of such systems a reasonable approach both financially and structurally.

If these Class 3, 5, and 7 agricultural land parcels are insufficient to meet the demand for developable land, then the Class 2 land parcels which are considered within the urban built-up area could be examined for development. These are land parcels which are already gone from the list of actively producing agricultural lands. Lands, which have been held for purposes of speculation but are still being farmed, are not in this category. The next consideration would be those lands in one of the following uses; transportation, unimproved pasture, unproductive woodland, or marsh. These lands, even though of higher agricultural capability, are potential development lands when adjacent to existing or planned subdivision construction.

By following the approach to urban development suggested in this section, two objectives will be met. The resulting development pattern will be contiguous and yet consolidated, while the best-quality agricultural lands will remain productive. Thus, as the urban centre grows it will consume lower-capability land while the adjacent farmland remains intact, thereby promoting a compatibility between urban and rural land uses.

MAP 19. LOWER-QUALITY AGRICULTURAL LANDS HELD FOR DEVELOPMENT.



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■ CLASS 3, 5 AND 7 AGRICULTURAL LANDS WITH NO SEWERS AND INCLUDES ALL LAND USES.


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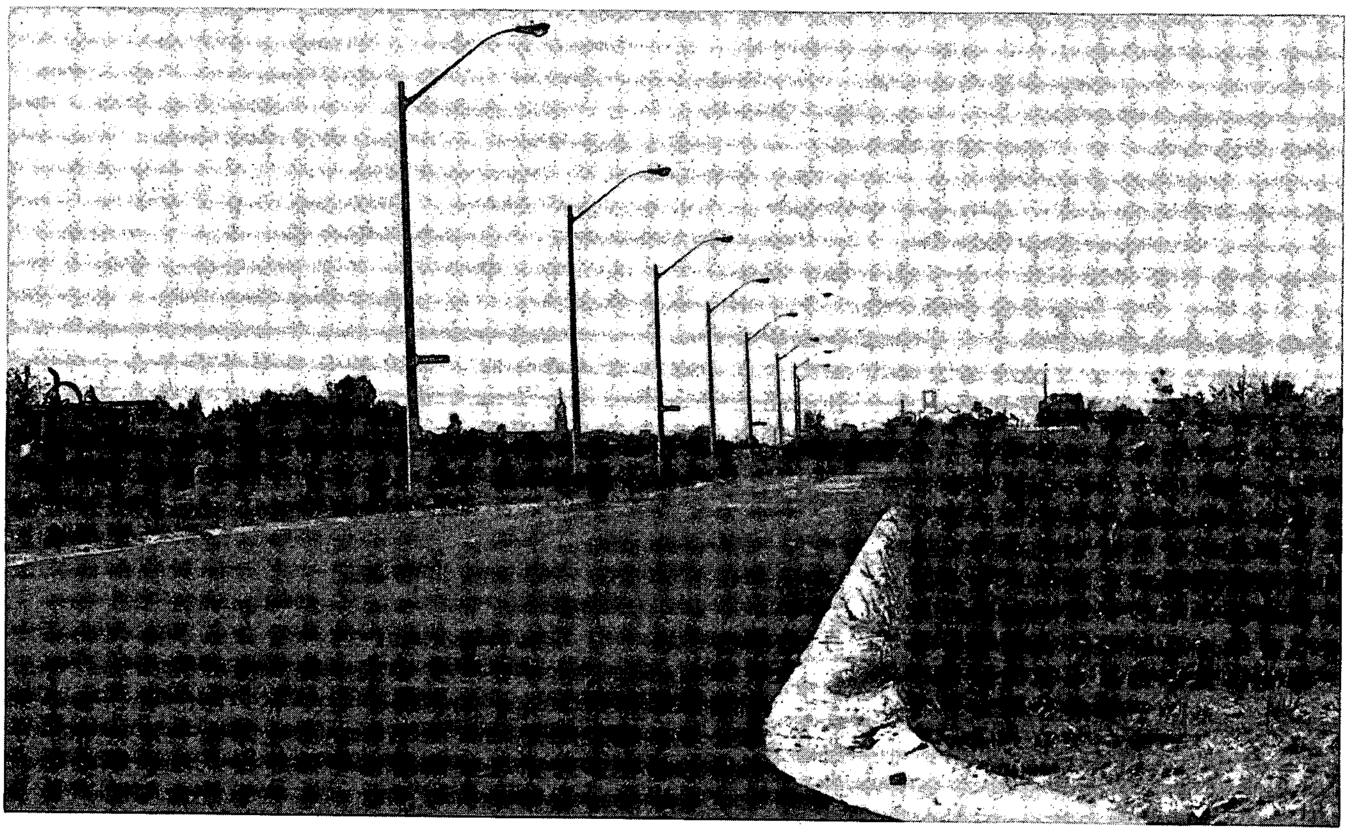
CONCLUSION

This report was an initial attempt to amalgamate two national data bases for the purpose of assisting land-resource planning. Information on sewers and subdivision plans from the LIM Program was transformed into a computer data base. This data base was amalgamated with CLI agricultural capability information to explore planning options for urban and regional growth around Windsor. The Canada Land Data System (CLDS) was used as the means to operationally explore such options. Clearly, it is possible for LIM information to be computerized for other Canadian centres besides Windsor, allowing similar data manipulations.

It can be concluded that the CLDS can be used as a means to analyze trade-offs between land capability and land undergoing urban development. As a planning tool, the CLDS allows spatial analysis and evaluation of land development based on various criteria, which can readily be changed or modified to suit particular user needs. The system permits models of land use to be constructed based on land capability as well as other associated land information.

Several possible alternatives for Windsor's growth have been constructed, based on the preservation of high agricultural capability land. In addition, the type of land uses affected by potential development have been identified and quantified. This should assist planners in predicting eventual conflicts between rural and urban land use so that these can be evaluated and addressed during the planning process.

Prior to the process of planning sewer extensions or sewer installations, the agricultural land capability of those land parcels should be examined. The applica-



tion of the land capability criterion should be included in the planner's presentation of the final plan to the local government officials. During the scrutinization of subdivision plans prior to their approval, the land capability should be checked and carefully considered before the final approval is given. Identification of present land use and the consideration of land capability for other uses, be it agriculture, recreation, forestry, or wildlife, are necessary to achieve the best planning decision.

The development of this methodology has shown that the important land resource base, in and around growing urban centres, can be used wisely. The Windsor area was selected as an example of a Canadian urban centre which faces planning decisions involving existing urban and non-urban land uses, with increasing land requirements for all sectors and a land resource base of varying capability for these uses. Through the analysis of its recent development, the Windsor case study provides an opportunity to offer alternative considerations which may promote a wiser use of the land resource.

Perhaps within the subdivision plan application form, a section could be added on Land Quality or Capability. Under this, the applicant would list if the site is Class 1 recreation, Class 2 agriculture, or similar such capabilities.

In summary, two strategies appear necessary in order to avoid the loss of high-quality agricultural land:

(1) land developers should be encouraged to acquire lower-quality agricultural land; and
(2) the development of high-quality agricultural lands already in the hands of developers should occur only after lower-quality lands have been developed.

The first strategy can be favoured by an infrastructure development program, a subdivision approval process, and an official plan with zoning which favours the areas identified by the optimal development model. Such actions should encourage the acquisition and development of these parcels.

With respect to the second strategy, the servicing, zoning, and subdivision approval process of lands *currently held* for development should favour the development of lands with the following characteristics:

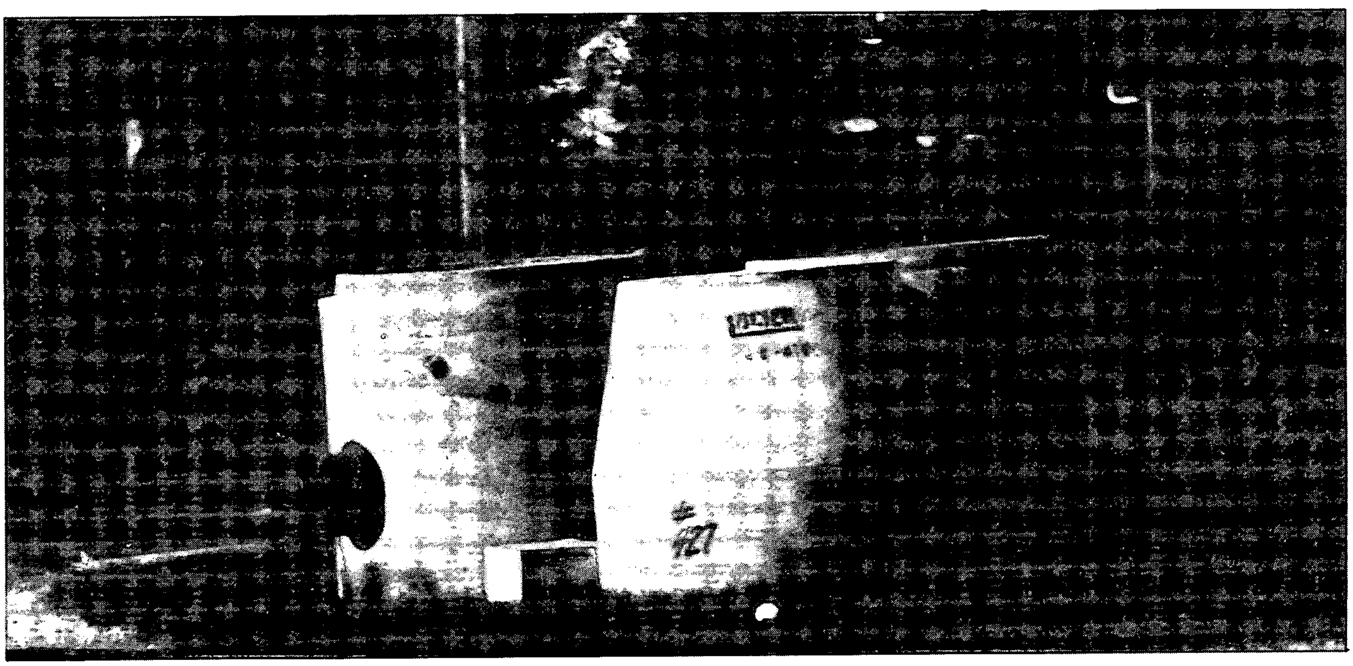
—Lower agricultural capability (Class 3 or lower in the Windsor area);

—parcels within the existing built-up area;

—parcels not currently in agricultural use; and

—parcels presenting no building constraints.

The application of these two strategies will contribute substantially to the conservation of the highest-quality agricultural land while permitting development to be directed to more-suitable lands.



POSTSCRIPT

A data application, similar to that presented in this report, is currently in progress for Québec City by the Lands Directorate's Regional Office in Québec. Such applications could be undertaken for any of the other 25 Canadian urban centres where both relevant CLI and LIM data bases are available. As no single approach can possibly work equally well for all centres, appropriate modifications are necessary to amend the optimal land development model. The methodology used to construct the optimal land development model is but one example of how various types of information can be manipulated to function as a planning tool. Such a model can readily be extended to include other site-related land capabilities, forestry, wildlife—ungulates, wildlife—waterfowl, or recreation. The flexibility of the Canada Land Data System allows the user to tabulate and plot the resulting spatial pattern of any of the models. A series of models based on a combination of such capabilities using a variety of trade-offs can readily be generated. Such capability models can assist in defining optimal regional land resource use.

Areas of potential land development have been defined using LIM information on sewers and subdivision plan status. Other information contained in this program, along with complementary data most pertinent to land development in a specific urban area, may be included to describe land-development actions. Such information may include existing or proposed roadways, commuter lines, commercial or industrial plans, zoning, or airport noise-cone patterns.

The use of optimal land models and analyses of potential land development could prove to be particularly useful around rapidly expanding urban centres such as Edmonton or Calgary. It may also assist in defining priority areas where detailed field investigation is necessary.

These are a few of the more-direct extensions and feasible applications. Future possibilities lie in effectively assisting decision makers in planning the use of land resources. Through the input of additional spatial land information, the optimal land-resource model and the potential land-development actions will be better defined. This will produce a more-effective tool for land planning. Subsequently, land-resource planners will then be better equipped to present quantified alternatives and options to the decision makers.

FOOTNOTES

[1] Canadian urban areas are defined as those with a population of 25,000 or greater.

[2] High-capability agricultural land is defined as Classes 1, 2, and 3 of the Canada Land Inventory Soil Capability classification for agriculture.

[3] Formerly, Central Mortgage and Housing Corporation.

[4] Sector 4 of this data set does not correspond precisely to the lands referred to as Sector 4 in the Land and Infrastructure Mapping Program. The former extends south of Amherstburg whereas the latter terminates at Amherstburg. This results in variation in data which should be noted if comparisons are made with CMHC inhouse computations.

[5] The figure is based on the average annual land consumption in Windsor 1974-1978 from the Land and Infrastructure Mapping Program 1979.

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APPENDIX I

Canada Land Data System

The Canada Land Data System (CLDS) is a computer system handling land-resource information and is part of Lands Directorate, Environment Canada. Its development was part of the Canada Land Inventory Program, a federal/provincial co-operative effort begun in the sixties. It was designed to assist in national, provincial, and regional resource planning thereby facilitating land-use planning and management. The Canada Land Inventory Map Series forms the major part of the 3,500 maps in the data base of the CLDS.

Lands Directorate is the primary client of the CLDS, although in the last number of years, its use has been diversified considerably to include other federal agencies, provincial agencies, and universities as well as other public and private organizations.

The Canada Geographic Information System (CGIS) forms the main software component of CLDS. The CGIS handles various types of thematic maps including, of course, the CLI land-capability maps. A map divides the earth's surface into irregular patches or polygons. Each polygon is assigned with a set of descriptive data related to it. The CGIS stores the spatial location and descriptors of such mapped data and provides a means of analysis and location of specific information. The polygons are converted to a digital format using an optical drum scanner or Interactive Digitizing and Editing Sub System (IDESS). The system can also handle point data as well as integrate with grid systems. Analysis of the data is achieved through the use of interactive graphic terminals or special software programs. Output is in the form of digital tapes, reports, and summary tabulations or visual displays of derivative maps of polygons through the use of graphic terminals with hard-copy devices, plotters, and various colour-display devices.

Two powerful features of the CGIS were used in the data analyses for this report. One was the means by which maps put into the system are transformed into a block structure for the whole of Canada. This permits adjoining map sheets to have their edges dissolved so that analyses are not limited to a map sheet to map sheet basis. A second feature is the CGIS's ability to overlay two or more thematic maps. In this operation, one set of polygon data is superimposed on another data set of the same area and the intersection and union for the two sets are determined. The system can overlay up to eight data sets in a single pass. This study specifically used agricultural land capability, land use, and infrastructure data as its three data sets.

This, very briefly, describes the rudiments of the computer system used in this research. More-complete descriptions of the computer system are available in *The Canada Geographic Information Systems — Overview*, 1973 (Report No. R001010) or the Introduction to the *Canada Geographic Information System*, July 1974 (Report No. R001020). Additional information may be obtained from the Chief, Canada Land Data System, Environment Canada, Lands Directorate, Ottawa, Ontario, K1A 0E7.

APPENDIX II

Classification System for Agricultural Land Capability

AGRICULTURAL CLASSES

1 No significant limitations for crop use
2 Moderate limitations that restrict the range of crops or require moderate conservation practices
3 Moderately severe limitations that restrict the range of crops or require special conservation practices
4 Severe limitations that restrict the range of crops or require special conservation practices, or both
5 Very severe limitations that restrict capability to produce perennial forage crops, and improvement practices are feasible
6 Capable only of producing perennial forage crops, and improvement practices are not feasible
7 No capability for arable culture or permanent pasture
0 Organic soils (not placed in capability classes)
8 Unmapped (unclassified) area

AGRICULTURE SUBCLASSES

With the exception of Class 1, the classes are divided into subclasses on the basis of kind of limitation. The subclasses are as follows:

C Adverse climate
D Undesirable soil structure and/or low permeability
E Erosion damage
F Low natural fertility
I Inundation by streams or lakes
M Low moisture-holding capacity
N Soils adversely affected by soluble salts
P Stoniness
R Shallowness to solid bedrock
S Cumulative adverse soil characterstics (two or more of D, F, M, N)
T Adverse topography
W Excess water
X Cumulative minor adverse characteristics
Z Water

APPENDIX III

Present Land Use 1972 Index Description

The possible land classes are:

B	Urban built-up
E	Mines, quarries, sand and gravel pits
O	Outdoor recreation
H	Horticulture
G	Orchards and vineyards
A	Cropland
P	Improved pasture and forage crops
K	Unimproved pasture and rangeland
U	Non-productive woodland
T	Productive woodland
M	Swamp, marsh, or bog
S	Unproductive land — sand
L	Unproductive land — rock
Z	Water
X	Transportation
8	Unmapped (Unclassified) area

APPENDIX IV

Definitions of Land Supply Characteristics

Private Developable:	designates that a parcel of land in a suburban area adjacent to existing or proposed sewers or water trunks, is in a growth area, or is owned by known builders or land developers.
Public Developable:	designates a parcel of land, usually vacant which is publicly owned in areas designated for residential growth or government land assemblies intended for residential development.
Sector:	is a division of a metropolitan area into a number of subregions based on direction and/or concentration of residential development.
Sewer or Water On Site:	designates a unit of land where existing piped services, with appropriate capacity, pass through or along the boundary of the site.
Sewer or Water Near Site:	designates a parcel of land where existing piped services with appropriate capacity are closeby (within 305 m of the boundary) and connection appears possible.
Sewer or Water — Planned:	designates a parcel of land where piped services are incorporated in existing plans and scheduled for future construction. The parcel must lie within the catchment area.
Subdivision Plan — Approved:	designates a parcel of land considered to have satisfied the requirements of the relevant authorities to the point where the developer does not have to negotiate further in order to begin installation of required internal services and construction.

A plan of subdivision is either registered, or has been approved for development with only minor conditions remaining to be met. Some of the major conditions in the Windsor area which would prevent a parcel entering this category were: where the developer had to build a pumping station to handle the storm sewer's increased load, and the developer had conflicting cost estimates for the station; also, the subdivision required another main road out of the subdivision (to relieve expected congestion in an existing contiguous subdivision) and the road is in the municipality's official plan but not in its current or immediate future's budgets.

Subdivision Plan — Submitted: designates a parcel of land for which the developer has submitted a plan of subdivision to the appropriate planning authorities.

17839

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