

THE IMPACT OF FLOOD PLAIN ORDINANCES ON RESIDENTIAL REAL ESTATE  
VALUES IN THE CITY OF WINNIPEG

by

Ladislav Jarolim

A thesis  
presented to the University of Manitoba  
in partial fulfillment of the  
requirements for the degree of  
Master of Science  
in  
Agricultural Economics and Farm Management

Winnipeg, Manitoba

(c) Ladislav Jarolim, 1986

Permission has been granted to the National Library of Canada to microfilm this thesis and to lend or sell copies of the film.

The author (copyright owner) has reserved other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without his/her written permission.

L'autorisation a été accordée à la Bibliothèque nationale du Canada de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur (titulaire du droit d'auteur) se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation écrite.

ISBN 0-315-33862-8

THE IMPACT OF FLOODPLAIN ORDINANCES ON RESIDENTIAL REAL ESTATE  
VALUES IN THE CITY OF WINNIPEG

BY

LADISLAV JAROLIM

A thesis submitted to the Faculty of Graduate Studies of  
the University of Manitoba in partial fulfillment of the requirements  
of the degree of

MASTER OF SCIENCE

© 1986

Permission has been granted to the LIBRARY OF THE UNIVERSITY OF MANITOBA to lend or sell copies of this thesis, to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film, and UNIVERSITY MICROFILMS to publish an abstract of this thesis.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

I hereby declare that I am the sole author of this thesis.

I authorize the University of Manitoba to lend this thesis to other institutions or individuals for the purpose of scholarly research.

Ladislav Jarolim

I further authorize the University of Manitoba to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Ladislav Jarolim

## ABSTRACT

Flood hazard is a growing problem throughout Canada. Traditionally, structural measures (such as dams, dykes, etc.) have been adopted to cope with a flood problem. In 1976, the Flood Damage Reduction Agreement (FDR) was signed between the Federal Government and the Province of Manitoba. Besides structural measures, this document has also emphasized nonstructural measures (such as floodproofing, zoning, etc.). On the basis of this Agreement the City of Winnipeg adopted restrictions on economic development (in the form of building codes) in flood hazard areas of Winnipeg.

It is often hypothesized that nonstructural measures depress property values in designated areas through the deprivation of property rights to manage one's property freely. The objective of this study was to test whether flood plain regulations have a negative impact on residential real estate values in the City of Winnipeg. Unfortunately, in this empirical test it was not possible to separate effects of flood plain regulations from effects of flood hazard itself (all flood plains are regulated in Winnipeg). A hedonic price model of residential property values was employed to investigate the hypothesized relationship. Data for the study were collected from the multiple listing of the Winnipeg Real Estate Board and consisted of actual transactions on single detached family houses sold in 1984.

Having encountered a problem of heteroskedasticity, the original sample of 172 observations was broken into three subsamples, each representing one particular area of Winnipeg (Fort Richmond, Elm Park and St.Norbert). It has been found that houses located in a designated area of Fort Richmond are valued more than comparable houses located off a designated area. The same result has been found for the Elm Park area but, this time, the difference was not statistically significant. The third sample, St.Norbert, did not satisfy all the assumptions of the estimation technique (OLS) and therefore the results could not be reported with confidence. Overall, it has been concluded that flood hazard and flood plain regulations do not have negative impact on residential real estate values in the City of Winnipeg.

It has been suggested that possible causes explaining this finding may be: low probability of flooding in Winnipeg (once in 160 year period); low restrictive nature of flood plain regulations; designated properties are often river properties which may have higher esthetic value, and therefore a higher price, than off the river located properties; the positive impact of structural measures put in place after the 1950 flood overwhelm the negative impact of flood plain ordinances.

## ACKNOWLEDGEMENTS

I would like to thank Derek Bjonback and Hasu Naik, IWD, Environment Canada for their guidance in setting and preparation of this research. I also thank Environment Canada, Inland Waters Directorate for funding this study.

Special thanks belong to Louise Arthur and Ray Bollman for their assistance in reviewing the research at various stages.

Further, I would like to thank the Winnipeg Real Estate Board, Manitoba Water Resources Branch and a number of individuals for providing data, maps and all additional information needed for successful completion of this research.

Last, but not least, I thank my wife, Lenka, and my daughters, Dita and Jana, for their understanding and encouragement in periods of doubts.

CONTENTS

ABSTRACT . . . . . iv  
ACKNOWLEDGEMENTS . . . . . vi

<u>Chapter</u>	<u>Page</u>
I. INTRODUCTION . . . . .	1
Flood Problem in Canada . . . . .	1
Historical Approaches to Cope with a Flood Problem . . . . .	2
FDR Agreement . . . . .	3
II. PROBLEM ANALYSIS . . . . .	5
Identification of a Problem . . . . .	5
Roots of the Problem . . . . .	6
Perception of Flood Hazard . . . . .	8
III. NEED FOR THE STUDY . . . . .	10
Flood Plain Regulations and Property Values . . . . .	10
Problems with Implementation of Flood Plain Regulations . . . . .	12
Literature review . . . . .	13
Summary . . . . .	16
IV. OBJECTIVES AND OUTLINE OF THE STUDY . . . . .	17
V. HISTORY OF FLOODING AND FLOOD CONTROL IN WINNIPEG . . . . .	20
Review of Major Floods . . . . .	20
Human Adjustments to Flood Risk . . . . .	22
Structural Measures . . . . .	22
Nonstructural Measures . . . . .	23
VI. HEDONIC PRICE FUNCTIONS (HPF) . . . . .	27
Basic Concepts . . . . .	27
Limitations of the HPF . . . . .	31
VII. EVOLUTION OF THE SPECIFIC MODEL . . . . .	33
Data and Data Sources . . . . .	33
Specification of the Model . . . . .	44
Functional Form of the Model . . . . .	46
Use of dummy variables . . . . .	49
Summary . . . . .	52



VIII. EMPIRICAL RESULTS . . . . .	53
Initial Regressions . . . . .	53
Linear Model . . . . .	53
Semi-log (in Xs) Model . . . . .	55
Double-log Model . . . . .	56
Semi-log (in Y) model . . . . .	58
Summary . . . . .	59
Validity of the estimated models . . . . .	60
Multicollinearity . . . . .	61
Heteroskedasticity . . . . .	65
Summary . . . . .	68
Linear and Transformed Models of Single Areas . . . . .	69
Adjustments for Heteroskedasticity . . . . .	69
Linear Models - Fort Richmond . . . . .	77
Linear Models - Elm Park . . . . .	82
Linear Model - St.Norbert . . . . .	85
Summary . . . . .	88
Final Models . . . . .	89
Final Model - Fort Richmond . . . . .	89
Final Model - Elm Park . . . . .	94
Summary and Implication for the St.Norbert Sample . . . . .	97

IX. CONCLUSIONS AND POLICY IMPLICATIONS . . . . .	99
---	----

BIBLIOGRAPHY . . . . .	103
------------------------	-----

<u>Appendix</u>	<u>page</u>
A. SAMPLE OF DATA . . . . .	105
B. SIMPLE CORRELATION COEFFICIENTS . . . . .	109
C. F-RATIOS FOR THE GOLDFELD-QUANDT TEST . . . . .	111

LIST OF TABLES

<u>Table</u>	<u>page</u>
5.1. Major Floods on the Red River at Winnipeg . . . . .	21
8.1. Linear Model - Initial Regression . . . . .	54
8.2. Semi-log (in Xs) Model - Initial Regression . . . . .	55
8.3. Double-log Model - Initial Regression . . . . .	57
8.4. Semi-log(in Y) Model - Initial Regression . . . . .	58
8.5. Linear Model - Fort Richmond . . . . .	78
8.6. Transformed Model - Fort Richmond . . . . .	79
8.7. Linear Model - Elm Park . . . . .	82
8.8. Transformed Model - Elm Park . . . . .	84
8.9. Linear Model - St.Norbert . . . . .	86
8.10. Final Model - Fort Richmond . . . . .	92
8.11. Final Model - Elm Park . . . . .	95

LIST OF FIGURES

<u>Figure</u>	<u>page</u>
5.1. Flood Risk Zones in the City of Winnipeg . . . . .	24
6.1. Marginal Implicit Price Function and Individual Willingness to Pay . . . . .	29
7.1. Designated Elm Park Area . . . . .	36
7.2. Designated Fort Richmond Area . . . . .	37
7.3. Designated St.Norbert and St.Germain Areas . . . . .	38
7.4. Relationship between the Number of Bathrooms and their Market Price . . . . .	48
7.5. Dummy Variable as an Intercept Shifter . . . . .	51
8.1. Price Function for Designated Houses . . . . .	93

Chapter I  
INTRODUCTION

1.1 FLOOD PROBLEM IN CANADA

Flood hazard is a growing problem throughout Canada.<sup>1</sup> It is estimated that over 200 places with population greater than 1000 have potential flood problems. This number would increase sharply if the list were extended to cover rural areas and small settlements.<sup>2</sup>

Due to the small population of Canada the flood problem was not considered a serious one until the 1950's. From that time on, however, the mitigation of floods was tackled on a large scale involving the efforts of both Federal and Provincial governments. Despite this effort and associated expenses it has been found that flood damages have still increased.<sup>3</sup>

Besides the direct damages caused by floods themselves there are lots of secondary damages such as a disruption of economic and social life, health problems (infections), loss of esthetics, etc. Some of these damages cannot be readily expressed in monetary terms.

---

<sup>1</sup> Freshwater and Arthur 1985,p.1.

<sup>2</sup> Framji and Garg 1976,p.130.

<sup>3</sup> Senjem and Freshwater 1981,p.9.

## 1.2 HISTORICAL APPROACHES TO COPE WITH A FLOOD PROBLEM

Historically two basic approaches to cope with the flood problem have been developed: the so-called structural approach which includes building of dams, dykes, diversions etc. and the so-called nonstructural approach which includes flood forecasting and warning systems, floodproofing, zoning, relocation, etc.

From history we have many documents about the structural approaches. Many of them have endured to the present times. But we also have documents about the nonstructural approaches. Thus J. Chia, the highest authority in charge of the Yellow River in China, prepared in 8 B.C. a flood control plan. He recommended that the best solution would be to abandon the considerable foreshore which was already densely populated, resettle the population and "return the land to the river, so as to provide ample space for the flood flow".<sup>4</sup>

It has appeared that both approaches have had both advantages and disadvantages and neither of them alone can eliminate flood damages.

Thus, a flood protective structure can protect a flood prone area against a flood to some designated level. Obviously it cannot protect the area against all possible floods because there is no upper limit to a flood's magnitude.

The nonstructural approach, which basically means to put some constraints in place on flood plains, has difficulties in implementation. As a population grows, an economy grows and utilization of resources increases over time. Consequently the pressure to make use of flood plains

<sup>4</sup> Framji and Garg 1976,p.xxi.

increases. In such a world it is very difficult to implement any restraining flood plain regulations, since they are usually viewed as an impediment to regional economic development. This applies especially to a local level where enforcement of any constraints is politically very difficult. After all, politicians have been elected to their offices to ensure economic prosperity, rather than to enforce any regulations which would interfere with that prosperity. Though floods themselves also interfere with the economic development the perception of flood risk by a general population may be very low (this applies especially to large floods with low probability of occurrence). It follows that possible flood losses may be seen by the flood plain inhabitants in a far future. On the other hand, the imposition of restraints on economic development has an immediate impact on the flood plain residents.

### 1.3 FDR AGREEMENT

In response to growing levels of flood damage and correspondingly higher levels of flood disaster payments, the Federal government through the Department of Environment introduced a Flood Damage Reduction Program (FDR). This involves joint federal and provincial efforts to identify flood hazard, reduce flood damages and limit unwarranted transfers of funds through the disaster assistance programs. This agreement was signed with the province of Manitoba in 1976. It includes reference to both structural and nonstructural approaches.

The basic approach for reducing potential flood damage is stated in the Agreement as follows:

- 2(1) The best results in reducing potential flood damage in the Province will be achieved if

(a) consideration is given, in each case where flood damage reduction measures are proposed, to all practicable structural and nonstructural alternatives, including the alternative of allowing some flooding to occur, so that the best choice on the basis of effectiveness, costs, corollary benefits and environmental impact is made; and

(b) preference is given, subject to paragraph (a), in areas determined to be flood risk areas, to measures that prevent or make subject to requirements for flood proofing all undertakings vulnerable to flood damage.<sup>5</sup>

While preference is given to nonstructural alternatives, in situations in which property is of sufficient value to justify structural measures such as dams or diversions, such protective measures may be employed. The criterion for evaluating effectiveness of structural alternatives is a benefit-cost ratio greater than 1.0.<sup>6</sup>

---

<sup>5</sup> Canada-Manitoba Flood Damage Reduction Agreements 1976.

<sup>6</sup> Freshwater and Arthur 1985, p.10.

Chapter II  
PROBLEM ANALYSIS

2.1 IDENTIFICATION OF A PROBLEM

From the historical point of view the early settlements were often established on river banks because of easy access to cheap transportation and because the land on the flood plains was usually more fertile than in other areas. So historically people had good reason to settle on the flood plains. However, as the settlements have grown over time property value has also increased and so has the value of flood damages. With the development of the state and its moral and ethical norms, society felt responsibility to help flood victims. Thus those members of society who experienced flood damages were compensated by the rest of society. We experience this situation at the present time. Since flood damage compensation paid to flood victims through the disaster assistance program have greatly increased over time, the Federal government has become involved in a solution of the flood problem.

The reasons for increasing level of flood damages can be identified as follows: increasing real value of property as a result of higher levels of individual wealth, expanded reporting of flood damages as a result of insurance claims and government disaster assistance programs, greater pressures to make use of flood plains as populations grow, particularly urban populations, and finally changing climatic and hydrologi-



cal conditions.<sup>7</sup>

The last reason for increasing damages, as stated above, is relatively new. It is mainly the changing climatic and hydrological conditions caused by the increasing amounts of CO<sub>2</sub> in the atmosphere. From the industrial revolution to the present times consumption of energy has increased rapidly. A particular cause of increasing amounts of CO<sub>2</sub> in the atmosphere has been the consumption of fossil fuels. The CO<sub>2</sub> acts as an insulator in the atmosphere so that with increasing amounts of CO<sub>2</sub> less and less warm air escapes into space and consequently the earth's atmosphere is warming. This so called "greenhouse effect" is expected to bring about noticeable changes in the earth's climate as early as the next century. As a result of those changes the central parts of the U.S.A. and southern parts of Canada are expected to become warmer and the main agriculture production would move further north. It is obvious that such changes in our climate would also cause substantial changes in hydrological conditions and thus in the pattern of occurrence and magnitudes of floods.

## 2.2 ROOTS OF THE PROBLEM

To look at the problem of flood mitigation it is useful to investigate roots of the problem in more detail. Thus one may ask what is the cause of increased flood damages? Is it "mother nature" or do people bring flood damages upon themselves?

---

<sup>7</sup> Freshwater and Arthur 1984, p.1.

Flooding is defined as a natural hazard but it is one for which individuals, to a certain extent, have some control over their probability of being exposed. Since floods occur in fairly well defined geographic areas, one can avoid exposure to flood hazard by choosing a location outside the flood plain. If we assume that on the whole people act rationally we would expect that they would choose such a location for their activity which is not subject to flooding. According to Becker (1962), this outcome could be expected even with people acting irrationally. He argues that irrational units would often be "forced" by a change in opportunities to respond rationally.<sup>8</sup>

There might be several reasons why people still locate in the flood plains. Most individuals location choices are governed by a number of factors other than the risk of a flood occurrence. These factors may be identified as budget constraints, commuting costs, employment opportunity, residence availability and the esthetics of the area. The choice of a particular location is based on a balancing of these various factors in a manner which results in the individual maximizing his or her expected utility.<sup>9</sup>

---

<sup>8</sup> Becker 1962, p.12.

<sup>9</sup> Freshwater and Arthur 1984, p.2.

### 2.3 PERCEPTION OF FLOOD HAZARD

The other reason why people inhabit flood plains in spite of damages caused by floods is a problem of flood risk perception. This is closely related to the availability of information about possibility of flooding.

There is a general lack of information about flood occurrence possibilities. Individuals in areas subject to infrequent floods are often unaware that they are in a flood prone location. This information gap may be spanned by providing the information through an external (government) agency. This is one of the objectives of the FDR Program: to provide the information about flood risk probabilities.

Even when individuals possess the information about relative frequencies of floods of different magnitudes, the larger magnitude floods, with lower probability of occurrence, may be discounted to a very small net present value. The obvious reason for this is the fact that floods are highly stochastic phenomena and the incidence of flooding does not follow a very well defined probability distribution. The problem lies mainly in the major floods which cause large amounts of damage but which have a very low probability of occurrence (i.e. a hundred year flood which is the flood of a magnitude that occurs, on average, once in one hundred years period). It is inherent in the nature of individuals to discount future events, especially those with a low expectation. Thus, even when individuals possess information about the relative frequencies of floods of different magnitudes, the larger magnitude floods with lower probability of occurrence may be discounted to a very small net present value. This implies that even when individuals perceive that a loca-

tion lies within a flood plain, there is little assurance that the individual's perceived flood hazard corresponds to the actual hazard. When we take the information gap into consideration, the result would be even more uncertain.

The perception of flood hazard by a population can also be learned by asking the people directly. Thus Rossi, Wright and Weber-Burdin (1982) surveyed both political elites and a general population in a number of communities across the U.S.A. in order to estimate the amount and content of support for and opposition to certain nonstructural disaster mitigation policies and programs. Though this survey is about natural hazards generally (not only flood hazard) and was done in the U.S.A., one could expect the same, or at least very similar answers to the questions here, in Canada. It is an interesting picture of how different groups of people perceive natural hazard and how they promote or oppose different approaches to cope with the problem according to their local group interests. In each case such a questionnaire gives useful information to a researcher who works on a flood mitigation program.

Chapter III  
NEED FOR THE STUDY

3.1 FLOOD PLAIN REGULATIONS AND PROPERTY VALUES

As mentioned earlier, both basic approaches to cope with flood hazard -- structural and nonstructural -- have some deficiencies. Each of them has some advantages and some disadvantages. It implies that to cope with the flood problem some combination of these two approaches should be used to maximize the efficiency of flood damage reduction.

Structural alternatives deal with the flooding problem by controlling the flood itself, whereas nonstructural methods deal with the use of the flood plain.

The most effective combination of these measures depends on a number of factors. Some of them are rather technical such as a terrain profile, soil structure, technical feasibility. Some others are economic and administrative. Finally, some problems are of a social nature. It appears that these are of major importance when dealing with nonstructural measures. As mentioned above, the nonstructural methods deal with the use of the flood plain. It means that an attempt is made to regulate property use, which, if it occurs after the property is acquired, is often viewed as a deprivation of property rights without compensation.

The restriction on rights to use the property freely implies a change in the expected flow of utility, which in turn reduces the value of the property, although the physical asset remains intact.

On the other hand, the structural measures -- if put in place -- may enhance property values in flood risk areas by lowering the level of expected damages. This expectation increases the level of expected utility and therefore increases the value of the property although the physical asset remains intact.

Thus, the private land owner always has an incentive to act in the political process for selection of structural measures that potentially enhance rather than reduce property values. However, from the political point of view, the general argument against structural measures is that one distinguishable group of people is subsidized at the expense of the general public treasury.<sup>10</sup>

Given this struggle over the use of the optimal mix of adjustments to flood hazard it becomes important to isolate and identify the magnitude of changes in property values. If such effect could be isolated, the validity of the preceding arguments would be tested. In addition policies of taxation or subsidies might be developed that would encourage political behavior and motivate the selection of efficient policies toward flood hazards.<sup>11</sup>

---

<sup>10</sup> Shabman and Damianos 1976, p.152.

<sup>11</sup> Ibid.

### 3.2 PROBLEMS WITH IMPLEMENTATION OF FLOOD PLAIN REGULATIONS

It has been said that flood plain regulations impose a deprivation of property rights without compensation. This points especially to the use of building and housing codes and to flood zoning regulations.

The method of building and housing codes represents special design and construction methods that make buildings less susceptible to flood damage. Building codes specify such factors as material types, sill levels, elevations and other construction parameters to ensure that in the event of a flood the damage to a particular site is minimized.

On the other hand, the goal of zoning regulations is to regulate an economic activity on the flood plain according to the probability of a flood occurrence. The advantage of zoning is that it can reduce an economic activity on the flood plain in accordance with the degree of the flood hazard. If the flood plain regulations are set up optimally, then only such economic development is permitted that results in a positive net value of benefits. It implies that when we take expected damage from flooding into account we are left with the greatest amount of net positive benefits and society moves to a higher level of welfare.

Besides the criticism that flood plain regulations represents deprivation of rights without compensation it is further argued that they also negatively affect property values (discussed above) and reduce the tax bases of regulated communities.<sup>12</sup>

---

<sup>12</sup> Muckleston 1983, p.1.

As a defence of these criticisms, it may be argued, that since society assists flood victims (in the form of flood damage compensation payments) then there is also the right for society to regulate use of the flood plain. The goal of zoning is to optimally allocate resources to different areas in order to maximize social welfare. When the individual does not act in a manner commensurate with the public interest, society has the right to take necessary steps to ensure that the individual does not harm society while pursuing his or her private interest.

These arguments sound logical but they are rather theoretical. In fact we can still expect a strong opposition to flood zoning from the side of property owners. This points especially to the hypothesis that the imposition of flood plain regulations reduce residential property values in regulated areas, which is of key interest to every property owner.

### 3.3 LITERATURE REVIEW

A number of studies have attempted to investigate the impact of flood risk and flood plain regulations on property values. Struyk (1971) studied the impact of flood hazard on agricultural land values on Missouri River in Kansas and Missouri. For his study he used appraisal data on the value of land and improvements. He found significant differentials in land values between flood-free and flood-prone areas attributable to flood risk. Senjem and Freshwater (1981) investigated the same relationship in the Red River Valley in Manitoba. They also found significant differences between flood-free and flood-prone parcels attributable to flood risk, the discount for flood risk parcels being 6 - 14



percent. Contrary to Struyk they used for their study actual data on land transactions.

Shabman and Damianos (1976) tested three hypotheses: (1) Flood-prone lands will have market prices lower than flood-free lands; (2) structural flood control measures will enhance the sale price of previously flood-prone land; and (3) land use control measures will reduce the value of land even beyond the reduction due to the flooding potential. Their first hypothesis was not rejected. The second hypothesis was not also rejected although the evidence was limited to one case study. Finally, the third hypothesis that nonstructural measures like zoning depress property values was not conclusive. The study was undertaken in Radford and Alexandria, Virginia.

Park and Miller (1982) investigated the impact of the National Flood Insurance Program (NFIP) on property values in Logansport, Indiana. The basic conclusion of this case study has been that, before the introduction of the NFIP, residential property values in the floodplain were less than fully discounted for the existing flood potential. According to authors, this finding gives strong evidence that overdevelopment, from the standpoint of economic efficiency, had occurred in the case study flood plain, most likely due to overly optimistic flooding potential perceptions and expectations of liberal federal disaster relief in the case of major flood.

In Canada, Babcock and Mitchell (1980) examined the relationship between flooding and property values for an urban community in southwestern Ontario. Their analysis of sale prices and assessment data demon-

strated no statistically significant differences in values of property for residences located in high - and low - risk areas of flooding.

Muckleston (1983) tested the impact of floodplain regulations on mean appreciation rates of residential land values in the Willamette Valley, Oregon. The study hypothesis that such regulations significantly depress appreciation rates of regulated lands relative to those of similar unregulated lands was in most cases rejected.

The Inland Waters Directorate (IWD) (1982) studied the impact of flood plain designation on real estate prices in three communities: the Buckingham-Gatineau-Aylmer area of Quebec, Winnipeg and Fredericton. The results were mixed. It appeared that in the Buckingham-Gatineau-Aylmer area designation has caused a reduction in the selling price of flood plain housing in the order of 15 - 20%. In the Winnipeg area designation appeared to have had a positive effect on the selling price of flood plain housing with increases averaging in the order of 10 - 15%. But these results were not generally statistically significant. Fredericton results indicated some positive and some negative effects but none were statistically significant. Overall, the results were considered inconclusive. Langford (1985) tested both the effect of flood hazard and flood plain regulations on residential real estate values in three small communities in the Winnipeg area. Some of the results showed significant price depressing effects, some did not.

### 3.4 SUMMARY

It has been stressed that the effective adjustment to flood hazard requires an application of both structural and nonstructural measures, and that the use of either measure has serious policy implications. It has been hypothesized that structural measures may enhance property values in flood hazard areas, enhancement being subsidized by the rest of society. Further, it has been hypothesized that nonstructural measures depress property values and reduce the tax bases of regulated communities through the mechanism of property rights deprivation.

The studies that tested the above hypotheses have shown mixed results. Thus, there is still the need for studies of this type. This applies especially to the impact of flood risk and flood plain regulations on residential property values. There are at least two reasons for this. First, as mentioned above, the results have not been conclusive so far and second, residential properties represent much higher concentration of wealth per given area than an agricultural property does. This fact is also reflected in the FDR Agreement that is focussed on the flood damage reduction of communities rather than of an agricultural land.

## Chapter IV

### OBJECTIVES AND OUTLINE OF THE STUDY

The basic objective of this study is an investigation of the impact of flood risk and imposed flood zoning regulations on residential real estate values in the City of Winnipeg.

The only study of this type in Winnipeg was done by the Inland Waters Directorate in 1982. The results showed a positive impact of flood plain designation on real estate prices with increases averaging in the order 10 - 15%, which was contrary to the proposed hypothesis. The results, however, were not statistically significant. This could be due to the fact, that the study was done just two years after the flood plain designation had been put in place in Winnipeg. The study also does not address any background information about flooding in Winnipeg, about the source of data and about what parts of the city were actually the subject of the test. Further, time series data were used for January 1978 to December 1981, which was the period of very radical movements in the level of interest rates. Since the interest rate is probably the most important factor in the demand for housing, the radical movements in it could distort results of the study.

Thus, there is clearly the need for a new study which would shed more light on the relationship between flood plain regulations and real estate values in the City of Winnipeg. To pursue this goal cross-sectional data were used. Those have the advantage that they are not distorted by

erratic movements in the economy over time. Further, a longer period of time has elapsed since the implementation of flood zoning regulations so that the housing market has had better chance to adjust to the new situation. A detailed description of the flood plain regulations, which are in place in the City of Winnipeg, is given in the next chapter.

The method to be used for testing of hypotheses in this study is a hedonic price function (HPF). This is the method which was used by the IWD, Shabman and Damianos and by many others especially in the other areas of environmental economics such as air pollution. The HPF is

a method for estimating the implicit prices of the characteristics which differentiate closely related products in a product class<sup>13</sup>

and as such it is suitable for pursuing the objective outlined above. The more detailed discussion of the HPF is presented further in this study.

The advantage of choosing Winnipeg for this kind of study lies in the fact that it is a large and relatively compact city with a large number of residential units. Due to this fact, sufficient amount of data could be obtained without the need to combine cross-sectional and time-series sources.

Within the basic objective it is necessary to focus on the role of information and its dissemination. The HPF approach assumes the perfect and costless provision of information. However, it has been noted many times that the information about flood hazard is often imperfect mainly because of a low probability of occurrence of major floods. Another cause

---

<sup>13</sup> Freeman 1979, p.78.

of the information gap may be a hesitancy of sellers to reveal flood risk of a property. In the case of this study the impact of flood plain regulations on residential real estate values is tested, rather than the impact of flood hazard. It is true, however, that the impact of the two is difficult to separate one from the other. It has already been mentioned above that flood plain regulations have also an informative role. In the case that an imposition of flood plain regulations depress property values, it is difficult to distinguish if it is largely because of increased information about flood hazard, or because of the restrictive nature of the regulations themselves.

Data for this study were obtained from the Winnipeg Real Estate Board. Data on actual market transactions are clearly preferable though professional appraisals for taxation purposes have also been used by different researchers. However, the appraisals must be used with caution since at least in some jurisdictions they may be systematically biased for political or other reasons.<sup>14</sup>

According to information obtained from the Assessment Department of the City of Winnipeg, the last assessments of residential land in flood risk areas of Winnipeg were done in 1960's. Since flood plain regulations in Winnipeg were adopted not sooner than in 1980, it follows that, given the objectives of this study, the appraised values could not be used for testing the hypothesis.

---

<sup>14</sup> Freeman 1979, p.131.

## Chapter V

### HISTORY OF FLOODING AND FLOOD CONTROL IN WINNIPEG

#### 5.1 REVIEW OF MAJOR FLOODS

Winnipeg is located at the confluence of the Red and Assiniboine Rivers, on the broad flat plain which was one time the bed of the glacial Lake Agassiz. Because of this flat character of the terrain, once the river leaves its banks, very extensive areas are subject of flooding. For example, during the well known flood in 1950 an area of 1350 square kilometers was flooded between Winnipeg and the international boundary at Emerson.<sup>15</sup>

Floods in Winnipeg have always been associated with the spring runoff period. The climatic conditions which lead to the likelihood of an extreme flood can be outlined as follows:<sup>16</sup>

1. A wet summer or fall in the preceeding year which thoroughly saturates the ground before freeze-up.
2. Cold weather with little snow during the early winter, allowing a deep penetration of frost.
3. A cold winter with heavy snowfall over the entire drainage basin.

---

<sup>15</sup> Report of the Royal Commission on Flood Cost-Benefit 1958,p.13.

<sup>16</sup> Ibid., p.14.