THE IMPACTS OF FLOODING ON THE TOWN OF CARMAN

1970-1980 WITH PROJECTIONS FOR THE FUTURE

FINAL REPORT

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A. EXECUTIVE SUMMARY

The town of Carman might be expected to be one of the most likely rural communities in Manitoba to experience development and growth over the next decade. It has a number of significant locational, cultural, and economic advantages. These, however, are tempered by the threat of severe flooding. Three major floods have occurred in Carman in the 1970-1980 period. In 1982, a major portion of the town of Carman will be designated as a flood risk area. Under the Canada-Manitoba Flood Damage Reduction Agreement this will preclude any further federal or provincial direct or indirect expenditure within the designated areas for activities that are subject to damage from flooding.

Although DREE has not undertaken major expenditures in Carman, the natural advantages of the town as a development centre for the region, particularly as an agricultural service centre, suggest that careful consideration be given to the potential for structural measures to alleviate flood hazard. In the past, a number of cost-benefit studies of various flood proofing schemes have been undertaken by the Water Resources Branch of the Manitoba Department of Natural Resources either alone or in conjunction with Environment Canada. The results of the studies have always indicated a benefit-cost ratio of less than one. Over the time of those studies the ratio has increased from 0.18 in the 1970 study to 0.9 in the January 1981 study for the Canada-Manitoba Flood Damage Reduction Steering Committee. Changes in the ratio can be attributed to a number of factors. These include changes in flood frequencies, changes in the value of property to be protected and changes in discount rates. Thus, various studies are not directly comparable. There is reason, however, to believe that over time the benefits associated with structural controls have risen relative to the costs.

Study Objectives

The objectives of this analysis are to:

(a) identify the economic structure of the town of Carman in 1980 and note how it has changed from 1970;

(b) appraise the impact of flooding on the town over the 1970-80 period; and

(c) project the future development potential of the town under the flood free and flood hazard conditions.

The town of Carman is located in the Rural Municipality of Dufferin, approximately 80 km southwest of Winnipeg. The surrounding area is very productive with fertile soils and a relatively long growing season. Provincial highways No. 3 and No. 13 intersect in Carman and both the CN and CP railways maintain lines that pass through the town. The town itself is situated on the banks of the Boyne River which meanders through a major portion of the town's area, with the downtown core and most of the residential development located within the 100-year flood plain of the river. The town has a population of approximately 2,500. Table 1 indicates that the town's population has experienced a significant increase over the 1956 to 1980 period.

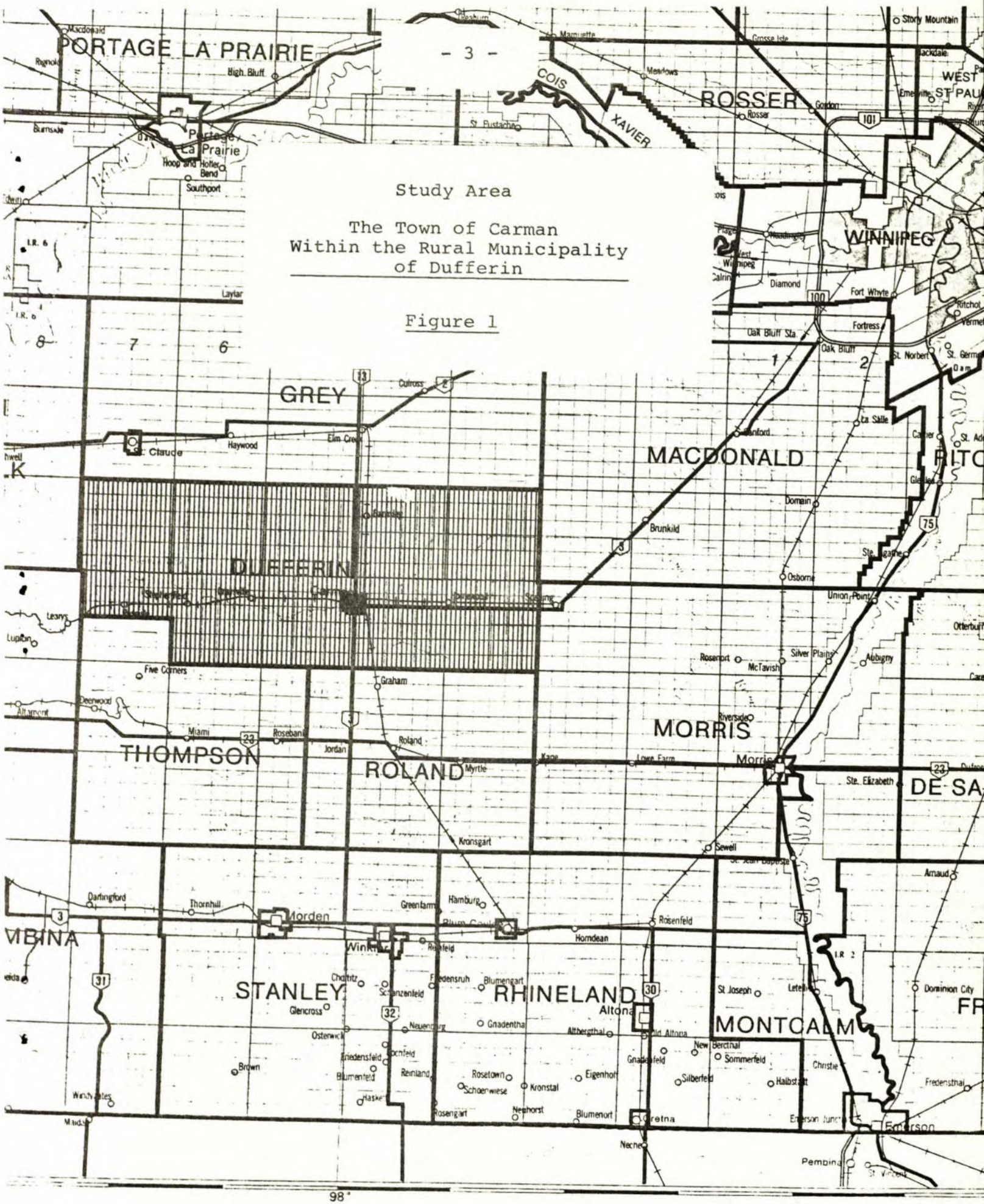
Table 1

Carman Population 1956-1979

Year	Population	Rates of Change From Preceeding Period
1956	1,884	
1961	1,930	+2.4%
1966	1,922	-0.4%
1971	2,030	+5.6%
1976	2,270	+11.8%
1979	2,468*	+8.7%

* MHSC Estimate

Carman is located in the centre of one of the most progressive and prosperous agricultural regions of Manitoba (see Figure 1). It is ideally located to take advantage of the growing input and marketing requirements of farmers who are making the transition from field crops, such as small grains and oil seeds, to row crops, such as corn and potatoes. These new cropping systems require the purchase of specialized equipment and increased inputs of herbicides, insecticides and fertilizer. These additional purchases create opportunities for input suppliers to expand their sales. Row crop producers also require specialized marketing and distribution systems, particularly drying and and storage facilities.



Study Area

The Town of Carman
Within the Rural Municipality
of Dufferin

Figure 1

It would also appear that the area around Carman is most likely to be one of the first areas to receive supplemental water for irrigation. Should this occur, there would be a significant increase in the intensity of production of high-value row crops, particularly corn, and the possibility of increased vegetable production. Thus projections of the value of agricultural production in the surrounding region suggest that Carman's role as an agricultural service centre will expand both in terms of traditional functions such as a supplier of consumption and investment goods and services and also in the provision of new activities such as corn marketing services.

In addition to its role as an agricultural service centre, Carman has also developed a specialized function as a retirement and recreation centre. A number of senior citizens' residential facilities are located in the town and medical facilities are in the process of being expanded. Currently the central core of the town is readily accessible by foot to most of these seniors' residences, enhancing the desirability of the town as a retirement location. Recreational facilities in the town are highly developed for a community of Carman's size. These include such amenities as a golf course, bowling alley, curling rink, movie threatre, campgrounds, swimming pool, baseball diamond, and agricultural exhibition grounds.

As a result of the wealth in the surrounding agricultural community and the concentration of retired individuals, Carman has also developed as a financial service centre. There are four banks, a credit union and offices of the federal and provincial agricultural credit agencies located in the town. These provide a range of financial intermediaries that is far greater than is generally found in communities of Carman's size.

On the basis of these observations, Carman would appear to be a viable community providing valuable services both to its residents and the surrounding area. The prospects for expansion and strengthening of these three primary functions in the future would appear favourable. Projections of demand for agricultural products, as well as farm income and expenditure suggest agriculture will do well in the future. The current demographic composition of the Manitoba population, particularly in rural Manitoba, suggests that retirement homes will be a growth sector. Finally, financial institutions would appear to be occupying an expanding role in the entire economy. Consequently, one might expect Carman to experience significant growth over the next decade in these sectors particularly, even in the absence of new activities locating in the town.

DREE expenditures in Carman over the 1970-80 period are depicted in Table 2. It indicates Regional Development Incentives Act (RDIA) expenditures have been concentrated in the agricultural processing sector. Expenditures through PFRA under the Agricultural Service Centres Agreement totalled $953,700. These are primarily for improvements to the local water supply. Further DREE expenditures will be conditional on implementation of the flood risk designation. If portions of Carman are so designated, only areas outside the 100-year flood plain will be eligible for DREE assistance.

Carman's primary functions as stated are as an agricultural service sector, a regional financial centre and a retirement/recreation centre. There are a few light manufacturing establishments mostly oriented toward the production of agricultural inputs. In comparing the industrial structure of Carman in 1970 and 1980 the limited number of manufacturing industries stands out. These have increased from four in 1970 to six in 1980 indicating very minimal growth in absolute terms. This can be contrasted with the agricultural industries sector which increased in the same percentages terms but went from 15 to 23. Most of these new firms either provide specialized inputs such as fertilizer or aerial spraying or marketing and processing services. Table 3 provides a breakdown of the town for 1970, 1980 and the associated percentage changes over the period.

Table 2

DREE Activity in the Carman Area

Program	Commitment/Expenditure
RDIA	
Carman Vegetable Storage	$ 27,750
Dufferin Feed Service	25,183
Seedex Canada Ltd.	288,075
Plains Processors	59,274
Carman Frosted Foods	26,544
Carman Concrete	34,458
Sub-Total	$461,284
VALUE-ADDED CROPS PRODUCTION AGREEMENT	
Corn Growers	80,000
INDUSTRIAL DEVELOPMENT AGREEMENT	
RDISI Projects	23,670
PFRA	
Agricultural Service Centres Agreement	953,700

Table 3

Carman Industrial Structure Breakdown

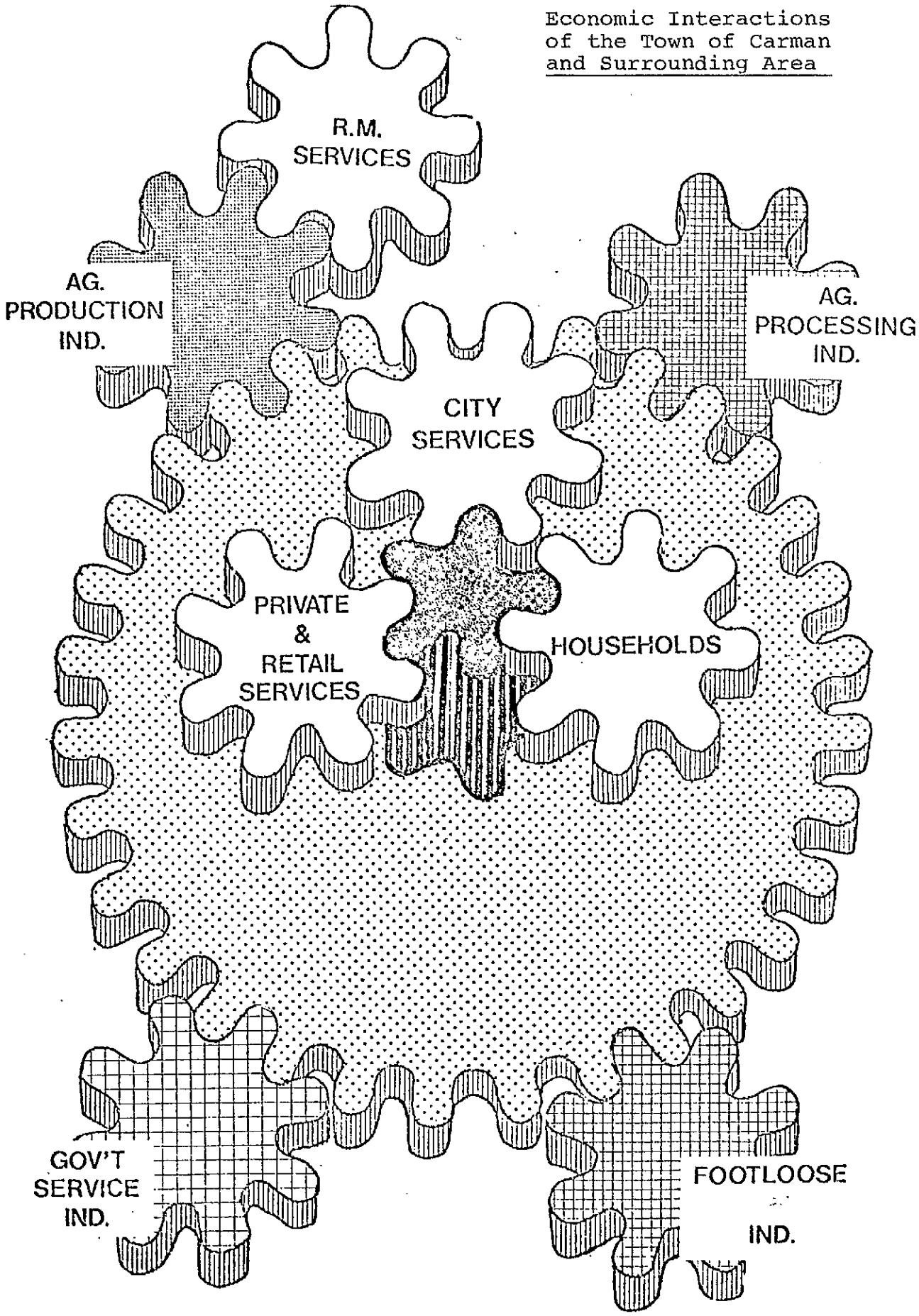
Industry	Number of Firms 1970	1980	Percent Change
Agriculture	15	23	Up 53%
Manufacturing	4	6	Up 50%
Construction	8	12	Up 50%
Transportation & Communication	17	10	Down 80%
Trade	51	65	Up 27%
Finance, Insurance Real Estate	8	14	Up 75%
Community, Business & Personal Service	54	80	Up 48%
Public Administration and Defence	9	11	Up 22%
TOTAL	166	221	Overall Up 33 %

Figure 2 depicts a theory of the economic interactions of the town of Carman and surrounding area. The large central gear represents the internal activities of the town involving the relationships between residents, their government and retail trade. These three groups are found within any community and although essential to the concept of a community are unable by themselves to keep the community viable. For small urban centres such as Carman some driving force or revenue generator is required. These "motors" sell outside the community, attracting external income to replace leakages from the local retail, residential and government sectors. If these motors are strong enough, the revenue they earn is more than enough to offset any leakages and the community grows. In brief, a "motor" is any sector which is oriented to providing goods and services outside the particular community in which it is located.

In the case of Carman, four "motors" have been identified. They are the historical functions of primary agricultural production, and agricultural processing, with government services and footloose industry being the other two. Government services in this context include senior government facilities that are oriented to provincial or

Figure 2

Economic Interactions of the Town of Carman and Surrounding Area



national concerns so that they deal with more than local residents. As the Carman area lacks raw resources necessary for primary industry other than agriculture and does not provide a large local market, any industry that is attracted will be of a type that is capable of transporting its inputs and outputs considerable distances. Such industries have been termed footloose because they are not restricted to locating in particular areas.

In the Carman situation, the retirement/recreation sector is an example of a footloose industry. While Carman does have certain aesthetic attractions that encouraged the development and expansion of the sector, it would also have been capable of developing in many other communities in rural Manitoba. In the case of retirement and recreational facilities there are economies of scale involved. Certain specialized facilities such as medical specialists or health care facilities develop where there is some critical mass demanding them. Similarly many recreational activities can use common facilities such as exhibition groups, or spectator seating and parking.

Existing economic activities in Carman place little strain upon the community's social infrastructure now that the water supply system has been upgraded. Existing revenues for the town cover the costs associated with the current level of social services. The major problem in Carman revolves around the impact of flooding and the high costs associated with any structural measures that are capable of alleviating the problem. Given the pending designation of the bulk of the town as a flood hazard area it would appear that unless some structural protection is introduced there will be major adjustments in the development pattern and structure of the town.

Major floods occurred in Carman three times in the 1970-80 period. In each case extensive property damage resulted but there was no direct loss of life. The floods occurred in 1970, 1974 and 1979 during the spring thaw. There is considerable controversy over the cause of the floods particularly in terms of the impact of upstream land clearing and drainage improvement. Regardless of the cause it is clear that flooding has a major impact on the town and its residents. Subsequent to each flood investigations have taken place to determine if a cost-effective means can be found to protect the town from floods of the Boyne River.

Previous benefit-cost studies of structural flood control devices for Carman have concluded that the benefits did not exceed the costs. Although there are grounds to suspect that the benefits projected in these studies understate actual benefits, the magnitude of the errors is not sufficient in itself to alter the conclusions drawn in the studies. The annual net benefits, even when raised by including omitted damages and expenditures, do not offset the costs associated with constructing a diversion.

There will, however, be a major change in the social environment of Carman in 1982 requiring a readdressing of the question of building structural devices. The Canada-Manitoba Flood Damage Reduction Agreement program will result in much of Carman being designated as a flood hazard area. This will effectively preclude any further construction in the designated area, forcing the town and its residents to make major expenditures on relocation outside the flood plain. The only way to avoid these expenditures is to protect the existing buildings from flood hazard with a diversion. With designation the two options available to town residents are either build a diversion to remove the threat of flood hazard or relocate the bulk of the town outside the flood plain. Each program involves major expenses but it would appear that the diversion is the least costly.

To provide an illustration of these changes a rudimentary benefit-cost analysis is presented. Under various assumptions of: growth rates in population, speed of abandonment of the flood plain and changes in construction costs, various benefit-cost comparisons were made. The results show that for a range of assumptions, construction of a diversion is the cheapest way to deal with the flood hazard problem of Carman given that the terms of the flood reduction program make the existing occupation pattern of the flood plain impossible. The values for benefits and costs presented are to be interpreted as representative rather than definitive. The dollar values employed in the analysis were chosen to examine the sensitivity of the benefit-cost ratio for the diversion to the impact of designation. Clearly prior to any actual construction, a more exhaustive analysis should be undertaken.

Summary of Conclusions

In brief, the conclusions of the study can be stated as:

(a) Carman possesses a unqiue set of advantages that would allow it to expand in size and income as special crop (e.g. corn) production expands in Manitoba.

(b) Prior to 1979 while flooding had not choked off growth in the town it had limited it. The 1979 flood, the third in a decade, had an impact upon individuals' willingness to invest in the community. Designation of parts of Carman as being a flood hazard area will result in major structural changes in the town, particularly deterioration of the central residential and commercial core.

(c) Designation also changes the "institutional rules" precluding Carman from continuing as it has in the past. The two likely options are gradual abandonment of the flood plain as occupants are squeezed out by financial barriers or construction of a diversion to relieve flood hazard.

(d) Using criteria consistent with Government of Canada Treasury Board recommendations, the diversion around Carman results in lower costs to society than gradual abandonment. Using the base set of assumptions the benefit-cost ratio associated with the diversion was 1.05.

B. INTRODUCTION

This report undertakes to examine a number of items in accordance with the requirements of the contract which initiated it. The objectives of the study involve:

(a) an analysis of the economic structure of Carman between 1970-80;

(b) an assessment of the impact of the flood hazard on the physical development of Carman; and

(c) an assessment of development strategies available to Carman, and how flood hazard affects these strategies.

To fulfill the objectives of the study, it was necessary to obtain and integrate considerable amounts of material on the nature of the Carman economy and that of the surrounding rural area, on the hydrology of the Boyne River and potential structural controls and on the expectations of residents in the area. Although much of this material was already in existence, it had not been integrated in the past. This, perhaps, is the primary contribution of the study.

The balance of the report is structured in a manner that provides the reader first with a general background in the recent history and geography of the area. Subsequently, the economic structure and function of the town are considered for the 1970-80 period. Given this basic information the three floods of the 1970-80 period are assessed in terms of levels and extent of damage. This material is followed by an analysis of the three previous flood damage reduction studies in terms of their methodology and conclusions. The development potential of Carman is introduced by consideration of the impact of the Canada-Manitoba Flood Damage Reduction Agreement. This leads to appraisal of the impacts of the adjustments to Carman that will be triggered by designation under the terms of the aforementioned agreement. Finally, a rudimentary benefit-cost analysis is undertaken to evaluate the impacts of designation versus a diversion, as solutions to flood hazard problems in Carman.

C. HISTORY OF THE TOWN OF CARMAN

The first settlement at the Carman townsite appeared on the banks of the Boyne River in the early 1870s. These initial settlers, in conjunction with the nomadic Métis, were responsible for the first drainage systems in the area, retrieving the land from the predominant marshes. Significant floods occurred in 1880, 1894, 1902 and in 1923. The next half century, however, was relatively flood free.

The settlement was first known as the Boyne, then renamed Carman after Bishop Carman. In 1887, the CPR line was completed to the townsite, and in 1900, the town was incorporated. Industry has always been predominant in the area. Prior to 1900, there were two flour mills, two saw mills, a planing mill, a sash and door factory, cheese factory and a construction firm located in the town. After the turn of the century, the mix of industry changed with an increased focus on agricultural production. The district, always noted for its excellent yields of grain crops, began the production of special crops such as corn, sunflowers and vegetables in the early 1930s. The soil and climate are such that the area boasts it has never known a total crop failure. The venture into special crops and the increased grain yields required the establishment of grain elevators, feed mills and other agricultural processing and ancillary industries.

A notable factor behind the town's progressiveness were the people. Carman developed one of the first Farm Business Associations formed in Canada, which actively pursued the study of farm management, cost accounting and agricultural education in general. In addition to taking their livelihoods very seriously, the people still found time to pursue recreational activities, exhibitions and fairs and the development of recreation facilities - the first golf course was constructed in 1927.

The town's industry has continued to focus on the agricultural sector. Carman acts as an agricultural service centre for the area by providing goods and services to its trade area population - predominantly agricultural services. Today several large implement dealers, fertilizer distributors, feed mills and agri-businesses dominate the commercial sector. Noticeable as well is the large increase in financial institutions to service the town and farm population.

Much of the dynamics in the agricultural sector are due to crop diversification taking place, with ever increasing acreages going into corn production. This is reflected in the recent establishment of related industries, for example the new Mancorn plant, now under construction. A major factor influencing prairie agriculture is the relative scarcity of water. Despite its flooding problem there have been water shortages in dry periods due to capacity problems in the town water plant. Current expansion of the plant's capacity should relieve this constraint. Since 1970, the town has experienced three major floods, resulting not only in extensive damage and expenditures, but developmental problems for the town.

In spite of the physical and psychological difficulties related to flooding damage, and the ongoing negotiations for flood relief, development in the town continues. Carman is well-known for its excellent recreation facilities and activities which attract people from the surrounding area. Construction activities continue; with new housing developments, a new hospital underway and plans for a shopping complex. Carman continues to encounter high competition for trade from its neighbours in the Pembina Valley - Winkler, Morden and Altona. Its ability to maintain its population and economy depend on its ability to resolve the problem caused by flood hazard.

D. GEOGRAPHY OF CARMAN AND THE RURAL MUNICIPALITY OF DUFFERIN

Geomorphology

The study area is situated in the Manitoba Lowlands, an area lying between the Manitoba Escarpment to the west and the Canadian Shield to the east. The average elevation above sea level is 850 feet, creating a natural drainage path directing waters from central Canada to Hudson Bay. The Red-Assiniboine Basin which drains southern Manitoba including the study area and eastern Saskatchewan is actually a secondary drainage basin. The primary basin it is part of, the Saskatchewan-Nelson, directs waters from eastern Alberta in the west and northwestern Ontario in the east into Hudson Bay.

The Lowlands were created by carving and gouging glacial activity during the various ice ages. The rock surface in the area consist predominantly of limestone, a soft, easily eroded base. During the retreat and melt of the glaciers, other depositional landforms such as moraines and gravel deposits formed in the area. The glacial melt waters collected in the low lying area and formed the large inland Lake Agassiz which covered at times 110,000 square miles. The predecessors of the Assiniboine, Pembina and other rivers drained into this lake forming their own impressions on the landscape. Gradually the lake retreated and Manitoba's topography as we know it evolved.

The town of Carman and the Rural Municipality of Dufferin rest in a lacustrine plain landscape, the former lake bed, consisting of flat to gently undulating relief. The surface deposits in the study area are medium textured clays and silts, except an area to the northwest consisting of sandy loams, known as the Almassipi Wetsands (once the mouth of the Assiniboine where it drained into Lake Agassiz).

The parent materials have given rise to an area of black soils, assisted by the lush cover of grasses that made up the natural vegetation and the inhibited drainage due to the flat terrain. The excess moisture discouraged tree growth, and until settlement, a large portion of the area was marsh and swamp. Streams from the bordering uplands produced heavy spring runoff and caused local flooding.

Since settlement, most of the area has been turned into rich productive farmland, with the main problem being water - lack or excess of. Water shortages for crop production

could potentially be resolved by irrigation programs, as much of the surrounding farm land is suitable for irrigation. Figure 3 illustrates the land suitable for irrigation in the area. Extensive drainage systems, which cover much of the Red River Valley, have resolved a significant portion of the excess water problem.

Climate and Agriculture

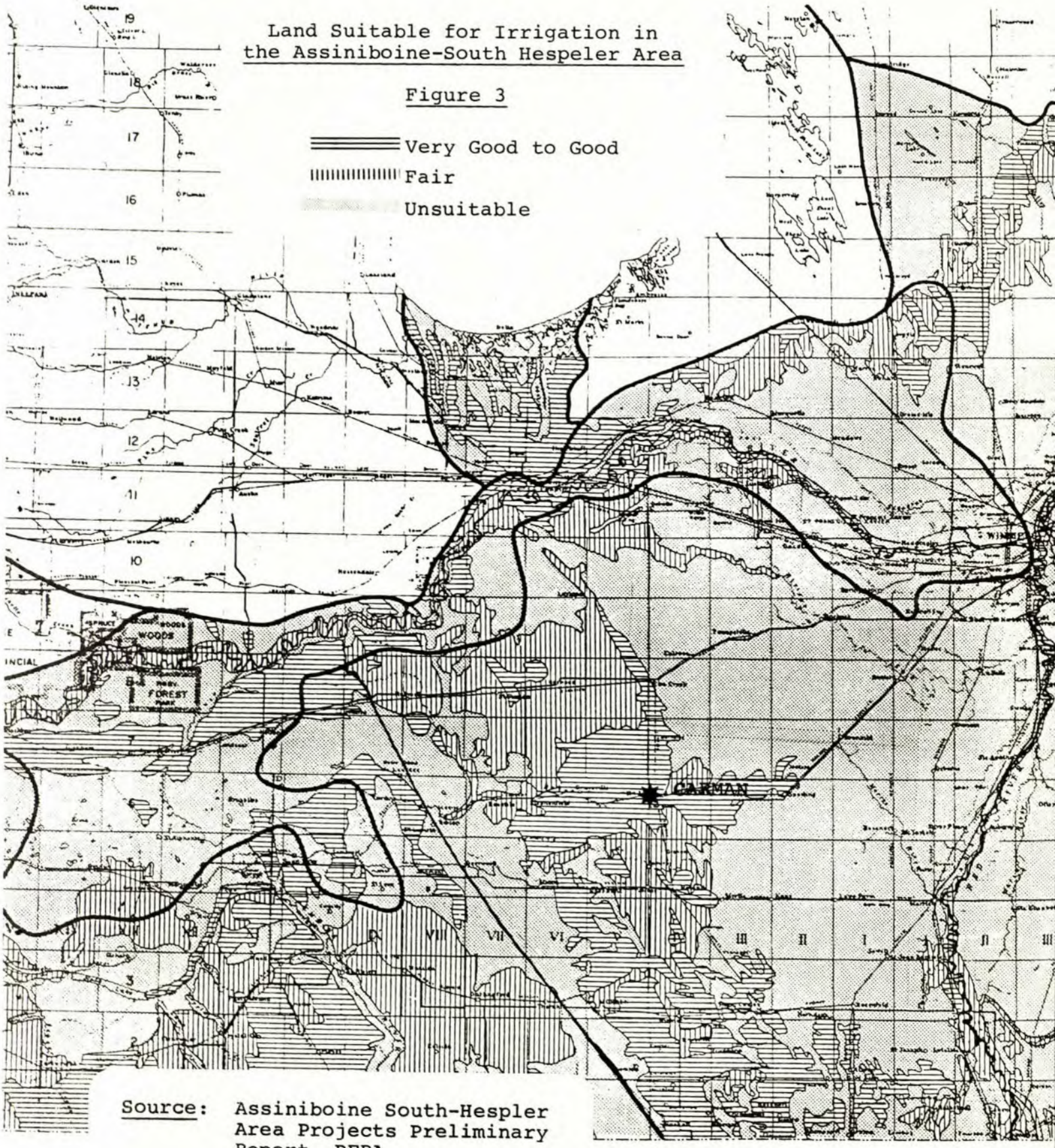
In an area where agriculture is the economic base, the number of frost-free days expected is of obvious significance. The longer the frost-free season, the greater the ability to plant crops with longer maturity periods, these usually being high-value special crops. The study area is located in the area of the province having the most frost-free days. In this area, modifying factors such as the proximity of large bodies of water and moist soils, are responsible for a growing season of up to 120 days in length.

Another important factor affecting crop yields is moisture. The average growing season precipitation is approximately 13 inches. This, along with the stored soil moisture, creates relatively favourable conditions for agriculture. Soil moisture, however, is dependent upon soil type and winter/spring precipitation. It is possible that fluctuations in all factors will produce severe soil water deficit. When considering average soil water deficit conditions the study area is located in one of the drier areas. This can have a detrimental effect on crop yields unless irrigation is undertaken. This has led to great interest in providing water for supplemental irrigation to the area.

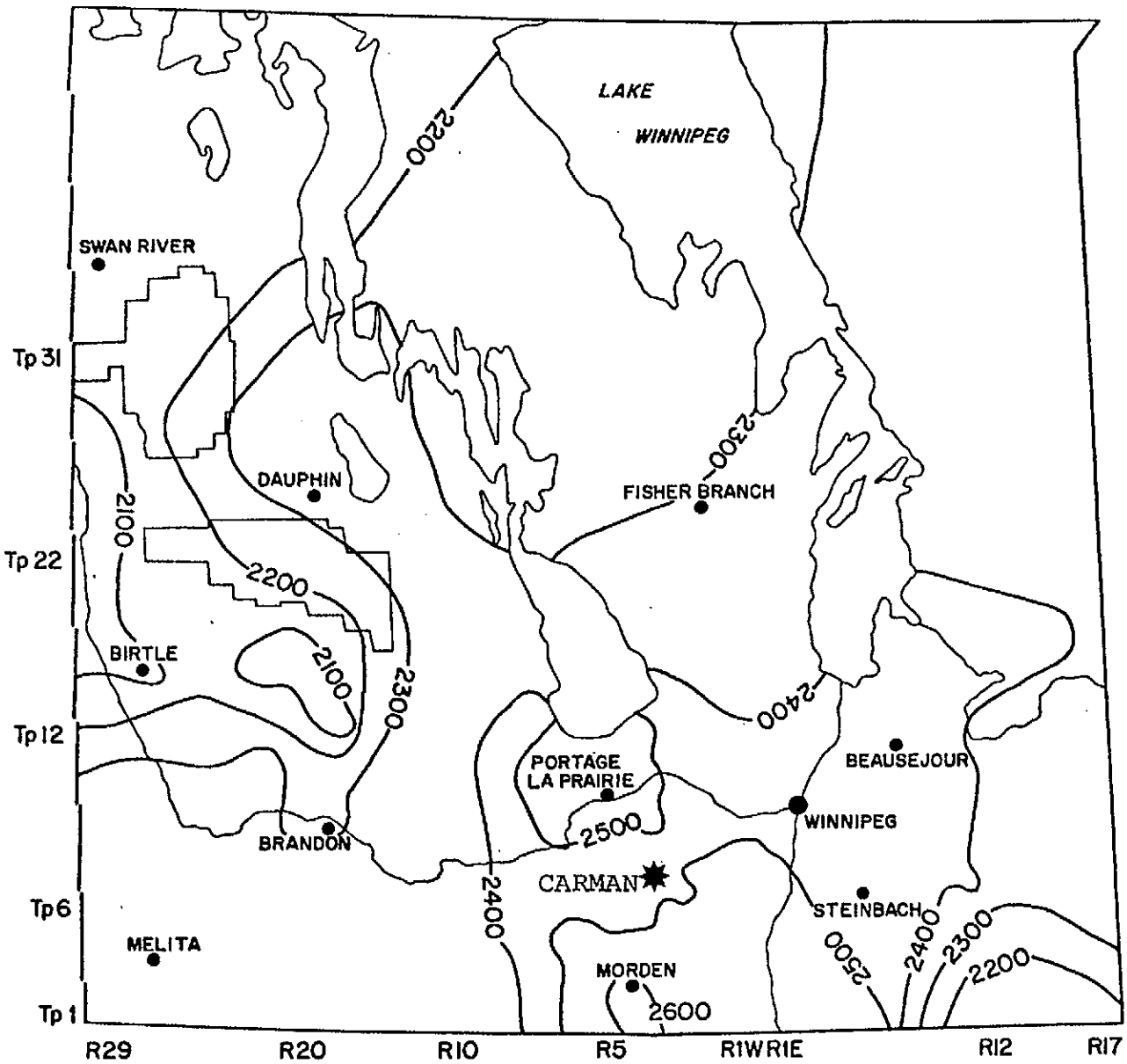
Seed germination and growth begins at 42 degrees fahrenheit or 8 degrees celsius, and increases exponentially with temperature rise to an optimum temperature. One form of measurement of growing season heat is degree days, the accumulation of average daily temperatures above 8 degrees celsius. Another form of heat measurement is the corn heat unit (CHU) now more widely used. Corn, in particular, requires warmer temperatures for growth than cereal crops. The CHU is calculated utilizing low and high daily temperature and averaging to provide a daily rating. These ratings are summed over the growing season to provide a seasonal rating. Figure 4, the rating map for southern Manitoba, indicates that the study area is located in one of the higher accumulation areas for the province. This is reflected in the increasing levels of grain corn production in the area.

Land Suitable for Irrigation in the Assiniboine-South Hespeler Area

Figure 3



Source: Assiniboine South-Hespler Area Projects Preliminary Report, PFRA.



Source: Manitoba Department of Agriculture.

CORN HEAT UNITS - MANITOBA

Figure 4

E. ECONOMIC STRUCTURE

Upon examination of the economic structure of Carman a number of interesting aspects are revealed. The most significant factor is that Carman is a highly specialized town in terms of function. The two major activities are both service related. The most important is the extensive agricultural service sector that has developed in Carman. The second is the retirement/recreation sector. Although all rural towns have a large involvement as an agricultural service centre, for various reasons Carman has managed to become a major regional centre exerting an influence that is disproportionate to its size. Similarly, the aesthetic qualities of Carman and its well-developed consumer services have contributed to its growth as a retirement/recreation area. Parallel to the highly developed nature of these two sectors, one observes that the manufacturing sector is very limited in the town. Compared to other towns in the Red River Valley of similar size, Carman has a very small manufacturing base.

This notion of Carman being an agricultural service complex is supported by analysis of the types of business within the various SIC classes. The firms located in Carman in 1970 and 1980 are listed in Appendix A and Appendix B, respectively. If the individual firms within each major group are examined most of them provide a product or service that is directly linked to primary agriculture either through sales or purchases. This includes firms supplying direct inputs such as machinery, fertilizer and fuel as examples. It also includes firms providing output services such as vegetable storage, grain storage, trucking services and agricultural product processing. There are less obvious links to financial institutions and consumer durable and non-durable retailers who obtain a large part of their revenues from sales to farm families.

In itself this is not particularly surprising. Small rural communities are oriented towards meeting the needs of the surrounding residents who are primarily farmers. The distinctive aspect of Carman's situation is the trade area associated with a number of these agricultural service firms. For example if implement dealers are considered Carman has five major dealerships. In the survey conducted of selected businesses in Carman the two implement dealers that were contacted indicated that over half of their sales were to individuals residing outside the Rural Municipality of Dufferin. A number of these sales were to United States residents. Thus Carman to some extent has a specialized function as a farm implement sales community similar to

Steinbach's role as an automobile sales specialist. This provides the community with a source of funds from outside its immediate area. In the terminology of export base theory, these implement dealers serve a basic or export function providing the town with the injections of external money that are necessary to keep the local economy from stagnating.

More recently Carman is developing specialist functions in fertilizer and pesticide sales and application, and in corn marketing. The progressive nature of farmers in the Carman area results in this part of the province being among the first to adopt new innovations in farming. As a result, Carman has an advantage in attracting the investment in agricultural support industries necessary to supply these innovators. As innovations are more widely adopted existing suppliers have an ability to expand their market. This results in the potential for expansion of the business in Carman, leading to increased revenue and employment opportunities in the town. This process results in a strengthening of the leading role of the agricultural service sector in generating employment and income in Carman. Given the widespread interest in corn production in Manitoba and Carman's central location in the area most suitable for corn production, the potential for continued growth of the firms supplying corn related goods or services would seem to be high. To the extent that this potential is realized Carman will be able to continue to attract purchasers from other areas of the province.

The relatively large number of financial institutions in Carman can also be explained by the town's agricultural service specialization. The five major financial institutions in the town have much larger facilities than a town of 2,500 people would normally support. The bulk of their business comes from farms in the surrounding area. The presence of numerous financial intermediaries also results in greater competition for customers allowing individuals to come to Carman and "shop" for financial services at one location.

Individuals coming to Carman to make farm related purchases also make expenditures on consumption items. As a result of non-locals coming to Carman to take advantage of its specialized functions there are additional sales opportunities for local retailers of consumer goods and services. These opportunities come in two forms - in the first case are direct sales to individuals who have come to town to shop for an implement or market corn. In the second case because these specialized sectors are larger than the local

market could support they in turn employ more people than one would expect so there is a local multiplier effect associated with the expansion of the agricultural services complex. Because Carman can provide a fairly wide range of shopping services it becomes more attractive. Rather than an individual having to make two lengthy trips, one for farm supplies, the other for consumption goods, to two different locations, a single trip can be made to Carman and both types of purchases made. These agglomeration effects, i.e. the clustering of a number of functionally unrelated industries, enhance the town's ability to attract individuals from outside its regular trading area.

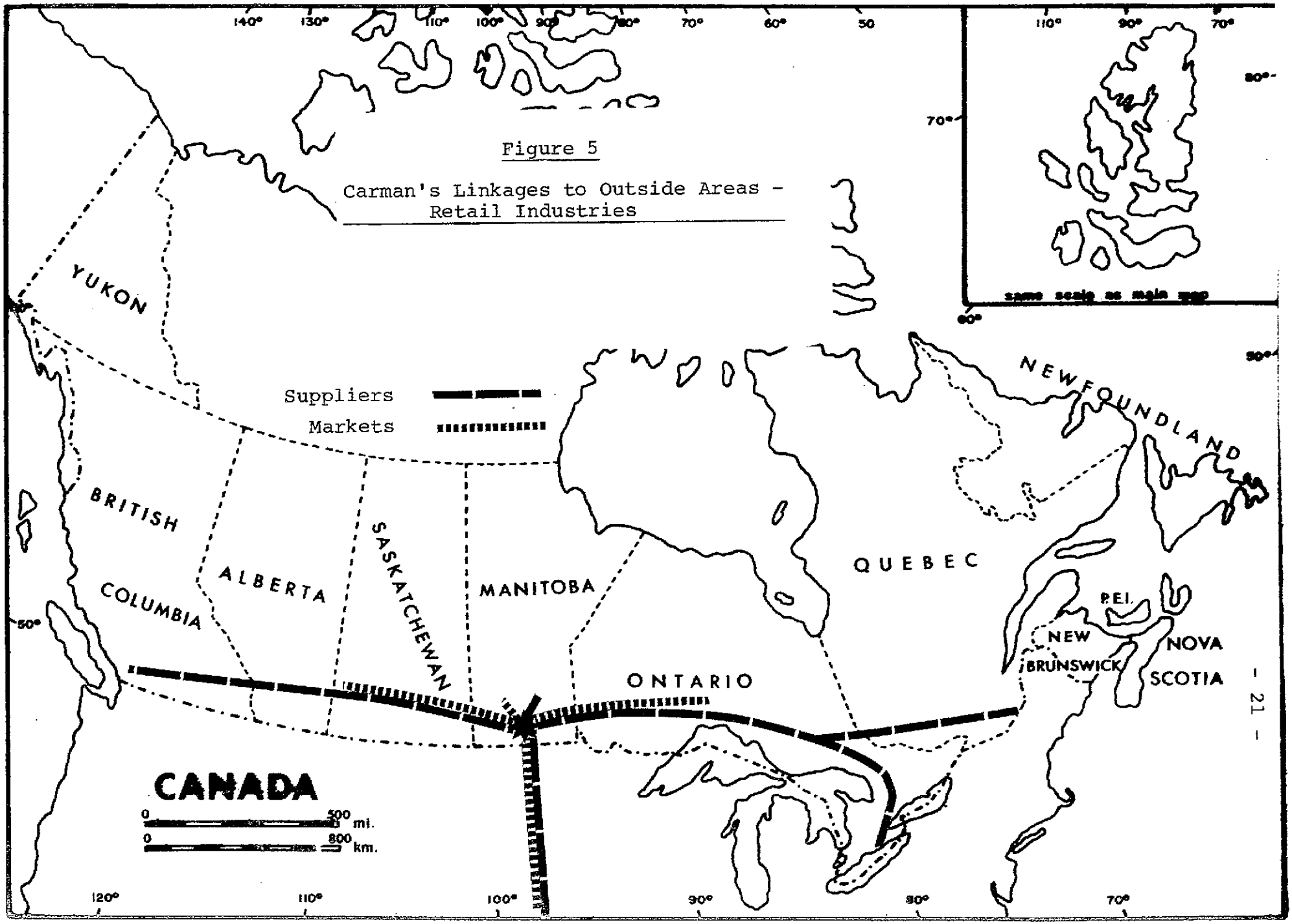
An indication of Carman's linkages with the outside world is displayed in Figure 5. This figure is based upon our survey results. Winnipeg is the predominant source of supply for the retailers in the community, however, there are national and international sources as well. The survey revealed that approximately 30 percent of Carman's trade takes place outside the community and the rural municipality. As evidenced in the figure, this portion has far-reaching markets for a town of Carman's size, with Saskatchewan, Ontario and the mid-west U.S. participating in the town's economy. This again is a reinforcement of Carman's specialization in the agricultural services and products sector.

The other major sector in town is the retirement/recreation complex. Retirement facilities in the town include three senior citizens homes and a personal care home. In addition there are recommendations that the existing hospital be converted to a senior citizen community centre when the new regional hospital is constructed. Since Carman is a regional medical centre it has a higher than average number of physicians. The ability to obtain medical assistance quickly also contributes to Carman's attractiveness as a retirement location. Currently Carman has a compact business district which is easily accessible from most of the residential areas and the senior citizens homes. Access to stores, restaurants, the community centre and churches is within walking distance. Recreation facilities in the town contribute to its attractiveness. The town has a golf course, bowling alley, theatre, ready access to ski resorts, exhibition grounds with a swimming pool and race track and the normal complement of baseball diamonds and tennis courts.

The impact of the retirement/recreation complex on the rest of the town is primarily through direct employment and an increase in the demand for consumer goods and services provided by the retail trade sector. There is direct demand for labour employed in the various senior citizens homes and

Figure 5

Carman's Linkages to Outside Areas - Retail Industries



particularly the personal care facility. These facilities employ approximately 100 individuals on a full time basis and a similar number on a part time basis. With the current forecasts of an expanding proportion of the population being over sixty-five and extended life spans, the potential for expansion at the demand for such facilities as senior citizen homes, personal care homes and senior citizen apartments is high. Thus Carman has potential for the size of this sector to increase in the future.

The low level of manufacturing in Carman can be explained in part by the success of the two previously discussed sectors. In the past Carman has not actively sought manufacturing development. There is no clearly designed industrial development strategy. There is no industrial park in the town and the development pattern of the town does not appear to reflect the need to provide serviced sites for industry in areas that will not conflict with current or future residential use. The current controversy over the relocation of A&M Soil Service because of its potential hazard to residential development is a reflection of this lack of development planning. To outside observers it appears that the town cannot decide whether the benefits of industry are sufficient to offset the inconvenience of having it there. In the past the capacity constraint imposed by the municipal water treatment plant on the supply of water may have contributed to the slow growth of the manufacturing sector. With the upgrading of the water treatment plant this constraint is removed.

As part of the process of appraising the structure of Carman a survey was taken of representative businesses in the town. Results of this survey are broken down by major industrial subgroups. The survey was designed to include representative firms for the particular subgroup. Thus the analysis is designed to be representative of the general economic structure of Carman. Actual values of sales, wages and employment were not asked but ranges were obtained. Thus any aggregation of the results of a particular questionnaire are only approximations of the true conditions. A copy of the survey questionnaire is attached as Appendix C of the report. Confidentiality restrictions prohibit disclosure of the information contained on the survey but the following generalizations can be drawn.

Table 4 summarizes ranges associated with broad categories of industrial types. Some notable features of the table are given below.

TABLE 4

AGGREGATED RESPONSES OF BUSINESS FIRMS TO THE SURVEY OF BUSINESS STRUCTURE IN CARMAN

(Firms are Grouped by General Industrial Type)

Industry Type	Number of Firms Surveyed	Range for Number of Full-Time Employees	Range for Number of Part-Time Employees	Annual Salary Range for Full-Time Employees	Proportion of Labor Force Residing In			Proportion of Sales to Residents of			Range for Average Value of Sales
					Carman	Dufferin	Elsewhere	Carman	Dufferin	Elsewhere	
Agricultural	4	6-10	11-15	10,400-14,560	45	50	5	5	50	45	500,000-1,000,000
Manufacturing	2	1- 5	6-10	10,400-14,560	60	40	---	20	30	50	250,000- 500,000
Capital Goods Trade	4	11-15	6-10	14,500-20,800	70	30	---	25	50	25	Over 1,000,000
Consumer Goods	9	1-5	1- 5	7,280-10,400	90	9	1	55	40	5	200,000-250,000
Consumer Services	5	11-15	6-10	10,400-14,560	70	25	5	40	40	20	250,000- 500,000

(a) In all instances, part time employees are a major component of the total labour force. In some instances, the number of part time employees is greater than the number of full time.

(b) The value of sales in the export oriented industries; agriculture, capital goods trade, and manufacturing were at least as high and typically higher than the sales levels of the locally oriented consumer goods and consumer service industries, indicating a strong ability to bring outside dollars into the community.

(c) In all cases the bulk of the labour force reside in Carman and average wages are considerably in excess of minimum wages.

It must be stressed that within each category there is considerable variation in the values reported by individual firms. The average values reported should not be interpreted as corresponding to any particular firm. The general impression obtained from the survey was one of a prosperous business community that currently faced a strong market for its products.

As a retail trade centre Carman has a fairly limited spatial influence. The lower Red River Valley is the most densely settled rural area of Manitoba. Carman faces direct competition from Morris, Morden, Winkler, Portage la Prairie and Winnipeg. Figure 6 indicates the respective trade areas associated with these communities. Consequently, the general retail function of Carman is fairly limited. Proximity to Winnipeg is the biggest factor constraining expansion of the consumer retail sector.

As noted previously Carman is located in an area with soils very suitable for irrigation. It is also an area particularly well-suited for the production of corn. Carman already has developed a leading role in the provision of implements and other inputs to corn farmers and in marketing and processing corn. Projected increases in corn production in Manitoba indicate that this is potentially a major opportunity for growth in Carman. As corn production increases the potential for increased processing and input sales will increase. At some point in the future there will be sufficient supplies of corn in the province to merit the establishment of a processing plant for corn starch. By virtue of its central location and major role in corn production, Carman would be a key possible location for such a plant.

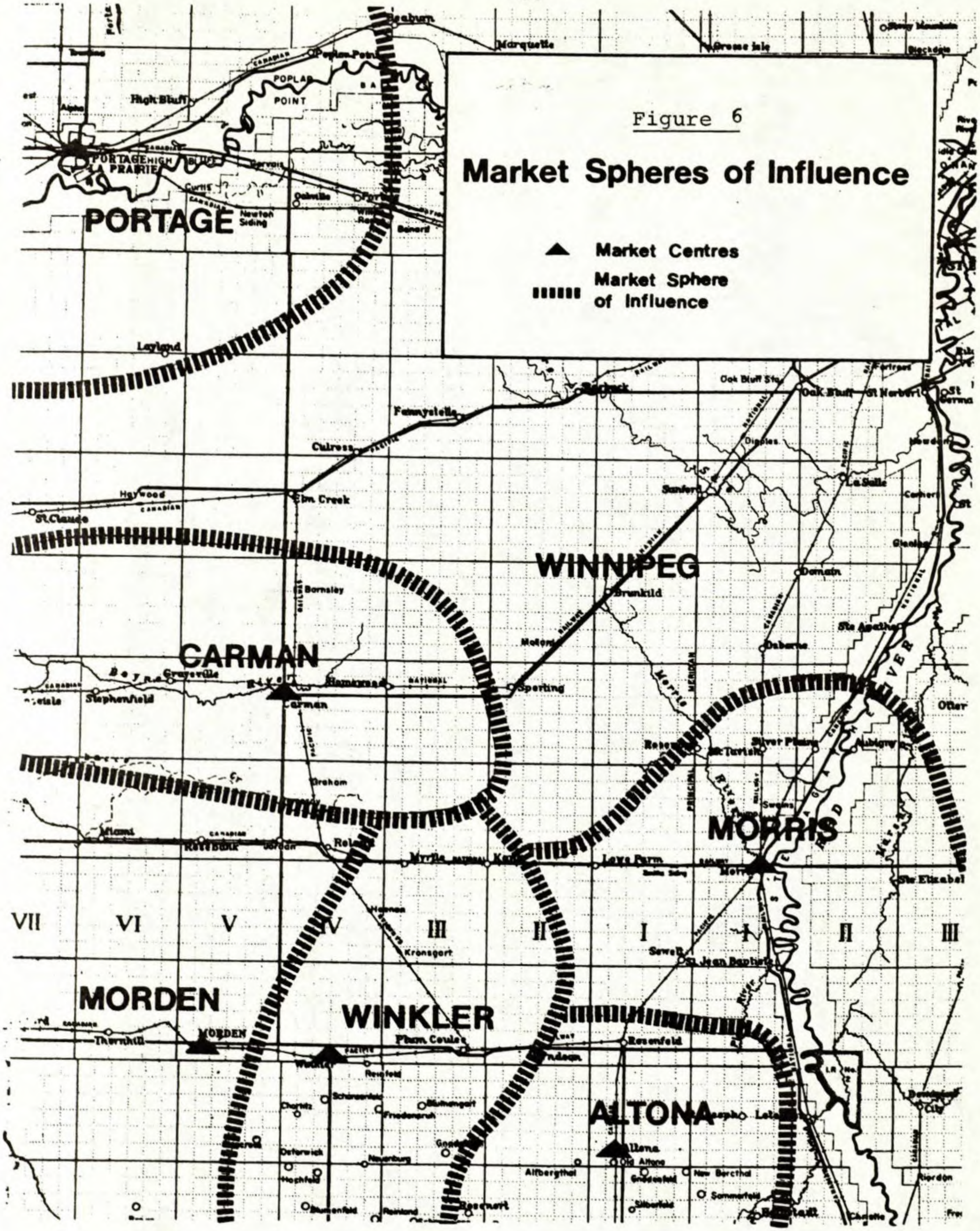


Figure 6

Market Spheres of Influence

Source: Winkler Development Plan, Manitoba Municipal Planning

In summary the economic structure of Carman is highly specialized in a few sectors. In the past the town has relied to a certain extent on natural growth of these sectors. This has taken place through the "individual initiative" of local entrepreneurs who have seized opportunities and made the best use of them. It would appear, however, that future progress will require a more orchestrated effort by the town collectively. Competition among communities for new employers is increasing as is the necessity to be able to tap programs offered by federal and provincial governments. Increasing capital costs make it difficult for an individual to begin a new operation without external financing. These factors suggest that Carman, if it wants to expand in the future, will require a development program which effectively utilizes the town's resources.

F. FLOOD HAZARD

Prior to 1970, flood hazard was an item of historical interest to the residents of Carman. Significant flooding occurred in 1880, 1894, 1902 and again in 1923. From 1923 to 1970, a period of 47 years, flood hazard was not a major consideration. In the 1970-80 period the capacity of the channel has been exceeded three times resulting in floods causing major damage. In addition flood warnings having resulted in expenditure of resources in preparation for what turned out to be unrealized flooding. Thus the last decade has provided a major change in the natural environment of Carman. Whether this is a permanent shift in flood hazard conditions is unknown but some long range forecasts of meteorological conditions suggest that the remaining decades of the twentieth century will be far more unstable than the preceeding forty years. One definite consequence of the flood conditions in Carman in the last decade has been a major shift in attitude of the residents of the community. Flood hazard and its associated costs are now major factors influencing the long range plans and day-to-day lives of the residents of the town.

The Boyne River generally has such a low flow that several weirs have been constructed along the reach passing through Carman in order to provide sufficient water levels to maintain the aesthetic value of the river and avoid odour problems. Water levels are also adjusted by controlling the outflow from the Stephenfield Dam which provides a reservoir for the town water system. The only time of the year where flood hazard is high is during the spring when runoff from the 461 square mile watershed located directly west of the town can result in stream flow which exceeds bank capacity. Previous studies by J. Friesen in 1975, and R. Bowering in 1980 detail the procedures employed to construct the flood frequency curve. It should be noted that over the 1970-80 period the 1 percent flood has been changed from 6,300 cfs in 1970 to 8,400 cfs in 1974 to 7,000 cfs in 1980. These adjustments reflect the differing evaluations by the hydrologists studying the river flow data as to the probability density function associated with flow rates on the river and the longer period of record giving more observations. In the case of Carman, stream flows of greater than 2,400 cfs start to cause some damage in terms of leaking basements while at marginally higher rates bank overtopping occurs, resulting in increasing levels of flood damage as the discharge increases.

The shape of the flood frequency curve is a major element in determining the outcome of the subsequent benefit-cost analysis conducted on the flood control projects. In particular since the flood frequency curve is derived through a curve fitting process using observed flow rates, the introduction of new observations, particularly where they are extreme values of very high or very low flows, can alter the distribution. Thus the observation of another high flow year causing additional flood damage would shift the curve once again to incorporate the additional information conveyed by that observation. Since flood frequency curves are derived using statistical techniques they are not deterministic relationships. This is particularly true when one is dealing with the extreme points of the curve where flow rates are very high or very low. From an analytical point of view it would be desirable to know how stable the curves are. More to the point it would be desirable to know the sensitivity of the results of the benefit-cost analysis performed in Carman to changes in flood frequency relationships. Although flood frequency curves developed by the Water Resources Branch show confidence intervals this information is not used in calculating benefit-cost ratios.

Spring flooding is the result of snow melting in the uplands of the watershed. The great variability in the peak spring flows trend at Carman can be attributed to the high degree of variability in snowpack and in the spring climatic conditions on an annual basis. In addition, there is a belief that changes in cultivation practices in the upstream portion of the watershed have contributed to flooding conditions in Carman. This belief has caused a long standing controvery between the town residents and the Water Resources Branch of the Department of Natural Resources. The following paragraphs present the general points of view held by the two sides but should not be interpreted as a definitive statement of the controversy.

As Figure 7 indicates the major portion of the Boyne watershed is located in a hilly area west of the town. This area has less fertile soils than the rest of central Manitoba and the rough topography and native brush cover made it less desirable for cultivation. With the increase in land prices higher crop prices and improved machinery, the area was extensively cleared in the 1950-70 period and land that was previously uncultivated was brought into production. It is argued that as a result of this clearing and field drainage there has been a change in the rate and volume of runoff in the upper reaches of the watershed. The contentious point in this argument is whether the change has been a major contributing force to flooding in Carman or a minor influence.

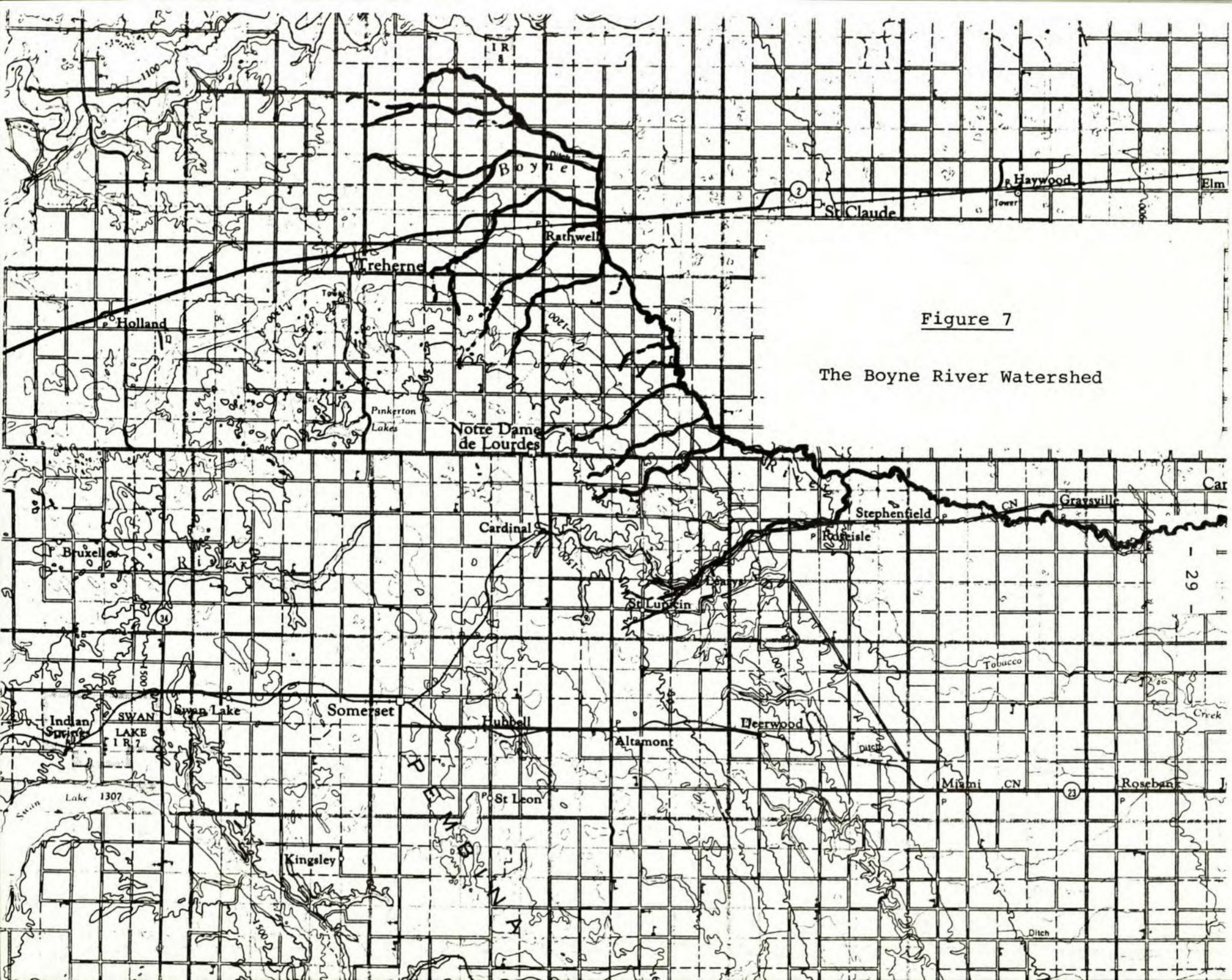


Figure 7

The Boyne River Watershed

The argument revolves around the extent to which clearing and drainage alters the snow melting and runoff pattern. Where the land remains in brush cover the brush controls snow drifting which keeps the snow from filling in ravines. Tree cover also slows the rate at which the snow melts and the trash cover under the trees can act in a sponge-like manner retaining water. As a result, the period of melting is spread out and the resulting peak flow is reduced. Long time residents of the area claim that in the past, prior to clearing of the upland area, two distinct peaks in stream flow could be observed. The first was the result of snow melting in the lower reaches on cleared land, the second from the later melting of snow that was sheltered from the direct rays of the sun. As a consequence, the likelihood of peak flows exceeding bank capacity was reduced.

After clearing it is argued that snow drifts into ravines where it fills them causing snow dams. With the clearing and cultivation of the land, the rate of melting is increased as there is no shelter from the direct rays of the sun. The dark color of the cultivated soil absorbs the heat of the sun speeding the melting process. Field drainage systems and the absence of trash cover contribute to rapid runoff of the water from the fields to the ditches. It is at this point that the filling in of the ditches and ravines with snow becomes important. Where ice or snow dams are formed the runoff from the fields is impounded and backs up until sufficient pressure is developed to break the obstruction. Where there are a chain of these ice dams and the initial break is in one in the higher reaches there is the potential for a domino effect causing a major flood. As the water from the first dam is released it moves downstream breaking the next blockage causing a rapid build up in the volume of water moving down the channel. As this process builds a phenomenon somewhat similar to a flash flood develops having a high peak discharge. Under this situation, the bulk of the spring runoff passes through Carman in a very short period of time as a single intense peak which overtops the river banks causing major flood damage.

The magnitude of the clearing effect becomes crucial because the cause of the flood problem is an important element in evaluating the desirability of flood-proofing Carman. If it can be shown that increased flood hazard in Carman is a direct result of clearing the watershed, then one must evaluate the benefits of the increased production from this land against the costs of flood hazard in Carman. If the benefits of clearing exceed the costs then the beneficiaries of the clearing scheme should compensate the town for the damages they have caused. If the benefits of clearing

do not exceed the costs then the land should be taken out of cultivation. To the extent that flood hazard in Carman can be directly attributable to actions taken by other individuals residing upstream, these individuals should be responsible for compensating town residents who suffer flood damage since the benefits they are reaping are causing costs to others.

If, however, the contribution of land clearing to flood hazard is minor, then the major flood hazard in Carman is a result of changing natural conditions. In this case it is less clear that there is a responsibility of members of society to provide flood protection to Carman on efficiency grounds. Resolution of the magnitude of clearing in peak discharge levels would require a detailed hydrological study of the watershed that included comparison of runoff from cleared and uncleared areas in various reaches of the watershed. Results of simulation models using synthetic data suggest that the magnitude of the impact is small particularly in the case of high peak discharges. Thus, although clearing may be a contributory factor to flooding, there would not be reason to conclude that in the absence of clearing Carman would not having flooding.

In 1970 the peak flood flow in Carman was 3,710 cfs; in 1974 4,670 cfs; and in 1979 4,630 cfs. In each instance the peak flows were in excess of 150 percent of channel capacity. Hydrologists argue that flows of this magnitude can only be achieved if the climatic conditions are exceedingly different from these normally experienced. A major problem in employing snowpack and current climatic conditions to forecast floods is the complexity of the relationship. It is possible to find years where there was a late spring, heavy snow cover and high levels of precipitation, yet no flood. To a great extent microclimatic conditions in the various portions of the 460 square mile watershed determine the rate of melt and the shape of the discharge curve. It would appear, however, that while land clearing has contributed to more rapid runoff, the volume of water added to the peak discharge level is very small. Major flood damage in Carman is primarily related to climatic conditions.

Although it does not appear that land clearing and drainage can be assigned the primary role in causing flood damage in Carman, they do appear to be contributory factors. Thus at the margin, a peak flow that is several hundred

cubic feet per second greater than it would otherwise have been results in damage that would otherwise not occur. This is a result of both a greater expansion into the flood plain than would otherwise be the case and greater depth of water in the base area that is flooded. Thus although one might conclude that natural causes are the primary factor leading to floods there is some incremental contribution from clearing. The fact that Carman experienced flooding in 1880, 1894, 1902, and 1923, which was a period prior to any drainage and clearing scheme in the upland portion of the watershed, substantiates the primary role of the climatic conditions, but does not negate the potential for additional flood damage resulting from clearing.

Irrespective of the reason that floods occur the objective of this analysis is to determine their impact on the structure of the town of Carman. Figure 8 is a map of the flooded area associated with the 1979 flood. Although the inundated areas in 1970 and 1974 are not precisely the same, the same general pattern occurred. It is apparent from maps and photographs of the town that the three floods of the last decade caused major disruption to every sector of the community including those whose property was not directly flooded. Previous studies have appraised the damages in various sectors of the economy and while there are some questions as to the magnitudes they assign, they do document the various groups involved. Following the methodology of the Ad Hoc Task Force on Flood Mitigation Projects the following five categories of costs will be considered:

(a) residential damage
(b) commercial damage
(c) lost personal income
(d) utilities, railroads, government property, streets, roads, flood fighting
(e) evacuation costs.

Table 5 reproduces Table 3.4 of the Task Force's report for comparison purposes. The following portion of the report considers the methodology employed in determining the magnitudes of the costs associated with each of the five categories.

Residential damage is divided into three categories:

(a) structures and contents
(b) driveways and landscape
(c) cleanup and moving of contents.

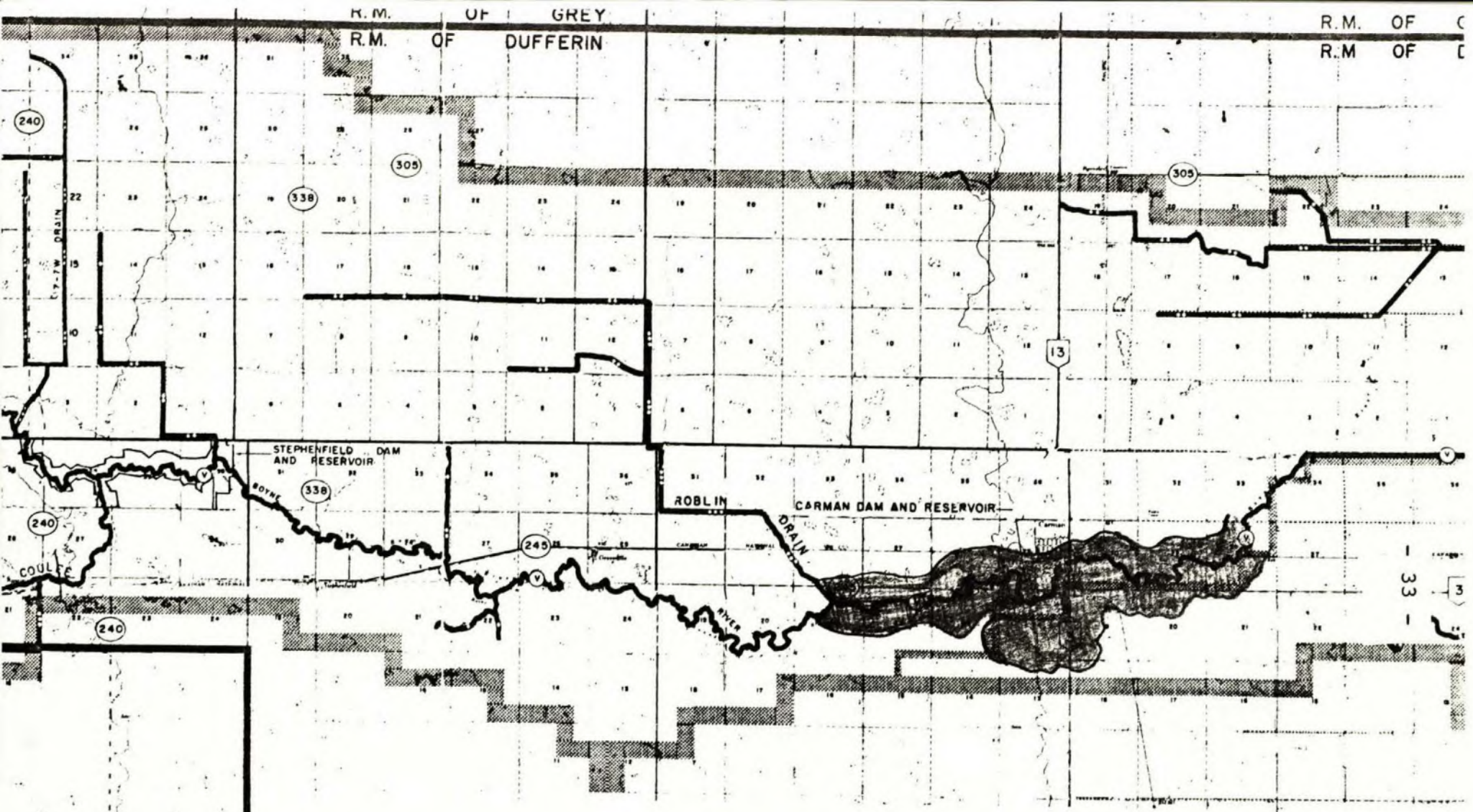


Figure 8. Flood Area Associated with 1979 Flood in the Vicinity of Carman.

Source: Fisheries and Environment Canada

TABLE 5

CARMAN FLOOD DAMAGES, 1979

REPRODUCED FROM THE REPORT ON MANITOBA FLOOD MITIGATION PROJECTS

RESIDENTIAL DAMANGE	
(a) Structures and Contents	$ 392,450
- 334 at $1,175 per structure (includes 296 structures within Town limits and 38 within the R.M. of Dufferin. Town structures were assumed to include hospital and elderly citizens' housing)	
(b) Driveways, Sidewalks, Shrubs, Lawns, Gardens and Fences	66,800
- 334 at $200 per structure	
(c) Cleanup and Moving of Contents	179,700
- 334 at $538 per structure	
COMMERCIAL DAMAGE	
(a) Business Structures and Contents (65 Businesses, 3 Farmyards, 5 Churches)	251,100
(b) Lost Net Profit before Taxes (includes Businesses Inside and Outside of Flood Zone)	213,800
(c) Valuation of Volunteer Labor for Moving of Business Inventory	252,000
- 56,000 man hours at $4.50 per hour	
LOST PERSONAL INCOME	
- lost earnings for floodzone residents and employees of flooded businesses.	138,100
UTILITIES, RAILROADS, GOVERNMENT PROPERTY, STREETS, ROADS AND FLOODFIGHTING	
- 30 percent of damage to residential and commercial structures and contents .3 X ($392,450 251,000) . Includes reported damages of $57,000 from the Town of Carman and $81,150 from the R.M of Dufferin.	193,050
EVACUATION COSTS	
(a) Alternative Specialized Accommodation and Transportation Costs for Hospital Patients and Residents of Senior Citizen Housing	33,900
(b) Evacuation Expenses and Extra Food Costs for Approximately 900 Persons forced to Leave their Homes	10,100
TOTAL (In 1979 Dollars)	$1,731,000
TOTAL (In 1981 Dollars)	$2,133,000

Category (a) structures includes the cost of repair of replacement to preflood conditions. Damage estimates are based on an average cost of $1,175 per resident. These damages included damage to basement floors and walls and to main floors. Damage estimates were obtained from a survey by the Carman Diversion Committee shortly after the flood. A survey carried out by the authors in the course of this study indicates that the figures obtained by the Diversion Committee could understate the damage. A number of individuals indicated that in the past year costs have been incurred that are directly attributable to flood damage. Electrical wiring and fixtures that were functional after the flood have since deteriorated and had to be replaced. Basements that did not have visible damage have started to leak and other structural defects have been discovered that were previously unreported.

In addition, the impacts of flood damage are cumulative in the sense that each additional flood results in greater structural damage. Thus houses which currently provide an adequate flow of services and are structurally sound will require major repairs if they are flooded again. From a social point of view the cost of not protecting these homes from flooding is the opportunity cost of the resources that will have to be allocated to the construction of a new replacement home. Thus one can argue that flooding results in a more rapid depreciation of the housing stock than would otherwise be the case and as a result society has to allocate more resources to residential construction than would be needed if flooding was not a problem.

The second category, commercial damage is subject to the same arguments as for the residential sector. In the case of category (b) lost net profit, these costs represent figures based on lost daily sales due to flood related closings. In a number of instances one can argue that these lost sales figures are really only deferred sales as customers will make their purchases when the stores reopen. However, for the majority of the businesses surveyed in our research it was felt that the sales lost in the period the operation was closed were permanently lost. Thus restaurants did not sell additional meals to replace those they did not sell, nor did grocery and drugstores recover all the business they lost because purchases were made elsewhere. Although most business operators did not perceive that flood closure resulted in any permanent loss of customers there were a number of instances where a customer was lost permanently as a result of failure to meet an order. In this case, the appropriate loss is not just the loss of the order but the discounted revenues that would otherwise have been obtained from subsequent orders that were lost when the customer was

lost. Since at the time of the Carman Diversion Committee survey it was not known that these permanent losses had taken place the net profit losses are understated. In one instance, the proprietor estimated that two customers each placing $20,000 in orders per year were permanently lost to an out-of-province competitor. In addition, a number of business owners indicated that in anticipation of the need to remove their merchandise and to minimize flood damages they reduce their inventory in the spring to levels below normal and consequently are unable to meet some of their customers' demands. Not only does this result in a loss to the particular business but it also imposes a cost on the customer who suffers a delay or may have to locate an alternate supplier.

Lost personal income should be based on estimates of lost earnings of flood zone residents and employees. In addition a number of individuals, particularly relatives of older people residing in the flood zone, lose income from time taken from work to help in the evacuation process. The method used in the previous studies simply takes 25 percent of residential damages. The rationale for this particular choice is not clear.

The fourth category is an omnibus collection of damages and is estimated as being 30 percent of damage to residential and commercial structures and contents. Aside from obvious questions as to why 30 percent is the appropriate figure, this category ignores a significant cost. Flood fighting is not an activity that is carried out solely by those affected directly by the flood. It also includes a large number of rural residents. These individuals, particularly farmers, provide not only their time but also equipment and often the labour of their employees. These inputs include heavy equipment such as four wheel drive tractors with ploughs for cutting ditches, tractors with loaders, trucks ranging in size from pickups to tractor-trailor units and the associated operators. Not only are the operating costs of this equipment important but also the associated depreciation and maintenance. After being used in flood waters equipment requires repacking of wheel bearings and a general overhaul. The cost of hiring a similar quantity of equipment from private contractors would add significantly to the expenses in category (d).

Category (e) deals with the costs associated with evacuating approximately 900 people from private residences and evacuating hospital patients and residents of the Boyne Lodge senior citizen home. For the local residents the costs of evacuation were relatively low because most individuals

stayed in private accommodation. There is a feeling among some residents in the town that evacuation contributed to deterioration in the health of a number of elderly residents and an earlier death for some of them. For residents of Boyne Lodge the evacuation costs were higher as these individuals had to be relocated in Portage la Prairie in similar facilities. In at least one case the resulting disruption and disorientation led to an accident for an elderly evacuee. Since the 1979 flood an addition to Boyne Lodge -Boyne Tower has been completed which would require the evacuation of a greater number of senior citizens.

It is instructive to look at the flood damages associated with each of the floods in 1970, 1974 and 1979. Table 6 presents a summary of damages using the classification scheme of the Ad Hoc Task Force. These figures are in current dollars. As a measure of expressing the figures in approximately constant dollars the figures are deflated to 1971 dollars using the Gross National Expenditure implicit price deflator as an index. The results are presented as Table 7. On a constant 1971 dollar basis, total damage is increasing over time, particularly in terms of residential damage and lost personal income. To some extent these increases reflect more accurate estimates of damages with each additional flood. Fewer individuals neglect reporting damage and there has been an expansion of the items considered as flood related damages with each flood.

Table 6

Carman Flood Damage by Category
1970, 1974, 1979, in Nominal Dollars

Actual Damage	1970	1974	1979
Residential Damage			
a) Structure & Contents	$ 95,601	$112,202	$392,450
b) Driveways	19,600	40,500	66,800
c) Cleanup & Moving	14,591	33,160	179,700
Sub-Total	129,792	185,862	638,950
Commercial Damage			
a) Business Structure & Construction	179,386	95,419	251,100
b) Lost Net Profit	34,757	19,155	213,800
c) Volunteer Lab	N/I*	21,850	252,000
Sub-Total	214,143	136,424	716,900
Lost Personal Income	11,280	22,500	138,000
Utilities, Railroads, Etc.	72,444	98,926	193,050
Evacuation	N/I	N/I	44,000
TOTAL	$427,659	$443,712	$1,731,000

* Not Included

Table 7

Actual Constant Dollar Damage Levels In Carman
For 1970, 1974, 1979 Floods -
Deflated With the GNE Implicit Price Deflator
for Domestic Demand, 1971 Equals $100

Actual Damage	1970	1974	1979
Residential	$134,499	$144,978	$325,497
Commercial	221,910	106,415	361,523
Lost Personal Income	11,689	17,551	67,474
Utilities, Railroads, Government Property, Streets & Flood Fighting	75,072	77,165	97,352
Evacuation	N/I*	N/I	22,189
TOTAL DAMAGE	$443,170	$346,109	$872,920
GNE DEFLATOR	96.5	128.2	198.3

* Not Included

G. PREVIOUS ANALYSIS OF FLOOD HAZARD IN CARMAN

After the flood of 1970 considerable interest was aroused in the possiblity of protecting Carman from flood hazard. This resulted in a benefit-cost study of engineering alternatives to control flood waters. It was concluded that the associated benefit-cost ratios were too low to justify construction. Following each successive flood, similar studies were undertaken and similar conclusions drawn. This chapter analyzes the methodology of the previous three studies and summarizes their results. Subsequently the methodology underlying the various studies is analyzed in terms of its implicit assumptions and their impacts on the results drawn. As noted previously the three studies of flood hazard in Carman and alternative structural controls concluded that the benefits associated with structural control did not exceed the costs. Studies were undertaken in 1971, 1975 and 1980. In each case a major flood had occurred in the previous year. The first two studies were undertaken by the Water Resources Branch of the Department of Natural Resources, while the third study was undertaken jointly by Environment Canada and the Province of Manitoba with provincial representation from the Department of Municipal Affairs in addition to the Water Resources Branch.

The three studies adopt a similar methodology and to a certain extent exhibit an evolutionary approach to the study of methods of providing flood relief in the Carman area. It is useful to examine these previous efforts because they provide both a starting place for the current investigation and a review of past conditions. In the remainder of this section the major features of each report will be examined and the changes that took place from report to report will be presented.

Following the 1970 flood, the proposals to provide flood protection to the town resulted in the provincial Water Resources Branch investigating both the magnitude of flood hazard in Carman and the costs and benefits associated with alternative control measures. Three alternative diversion routes were considered in this report as proposed means to protect Carman from flood damage. For all three the computed benefit stream did not exceed the costs of construction. Consequently, it was concluded that "... a flood diversion channel to provide protection to the Town of Carman cannot be justified on an economic basis."(1)

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1. Planning Division, Water Resources Branch, Manitoba Department of Mines and Natural Resources, Benefit-Cost Study of the Boyne River Diversion at The Town of Carman Unpublished mimeo, p.iv., January 1971, Winnipeg.

The suggested cause of the 1970 flood in this study was the late ice breakup in combination with abnormally high precipitation prior to and during the spring melt.(2) On the basis of the damages that occurred in the town and a computed flood frequency curve a frequency-damage curve was calculated. On the basis of the information available and assumptions employed at the time, the 1970 flood was estimated to have a recurrence period of 31 years while the 100-year flood would have a discharge of 6,300 cfs.

Estimates of the damages associated with the 100-year flood were compiled by calculating the area of the town that would be inundated and then determining the water level in each building. From this, damage values for each building were calculated using the Templeton curve developed for the 1958 Royal Commission on Flood Costs and Benefits. The sum of these individual damage levels became the expected costs of the 100-year flood.

An expected annual benefit from a flood control structure was calculated from the flood frequency-damage curve. For each alternative diversion an annual cost was developed by amortizing the construction and maintenance costs over a fifty-year life using a 7½ percent interest rate. These average annual costs were compared to the annual benefits to obtain a benefit-cost ratio. Table 8 reproduces the benefit-cost ratios. The alternative diversions are indicated in Figure 9.

Table 8

Annual Benefits and Costs Associated With Alternate Diversions in the 1971 Flood Damage Reduction Study

Average	Alternative 1	Alternative 2	Alternative 3
Average Annual Benefit	31,680	31,680	31,680
Average Annual Cost	174,501	157,687	175,742
Benefit-Cost Ratio	.18	.20	.18

The second study was completed in January 1975 following the flood of 1974. Methodologically, it is a direct descendant of the 1971 study. The principle differences are a new set of flood control devices which were proposed, the flood frequency curve was re-estimated, additional types of damage were introduced, and the discount rate used to amortize the construction costs was changed to 10 percent.

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2. Ibid, p.2.

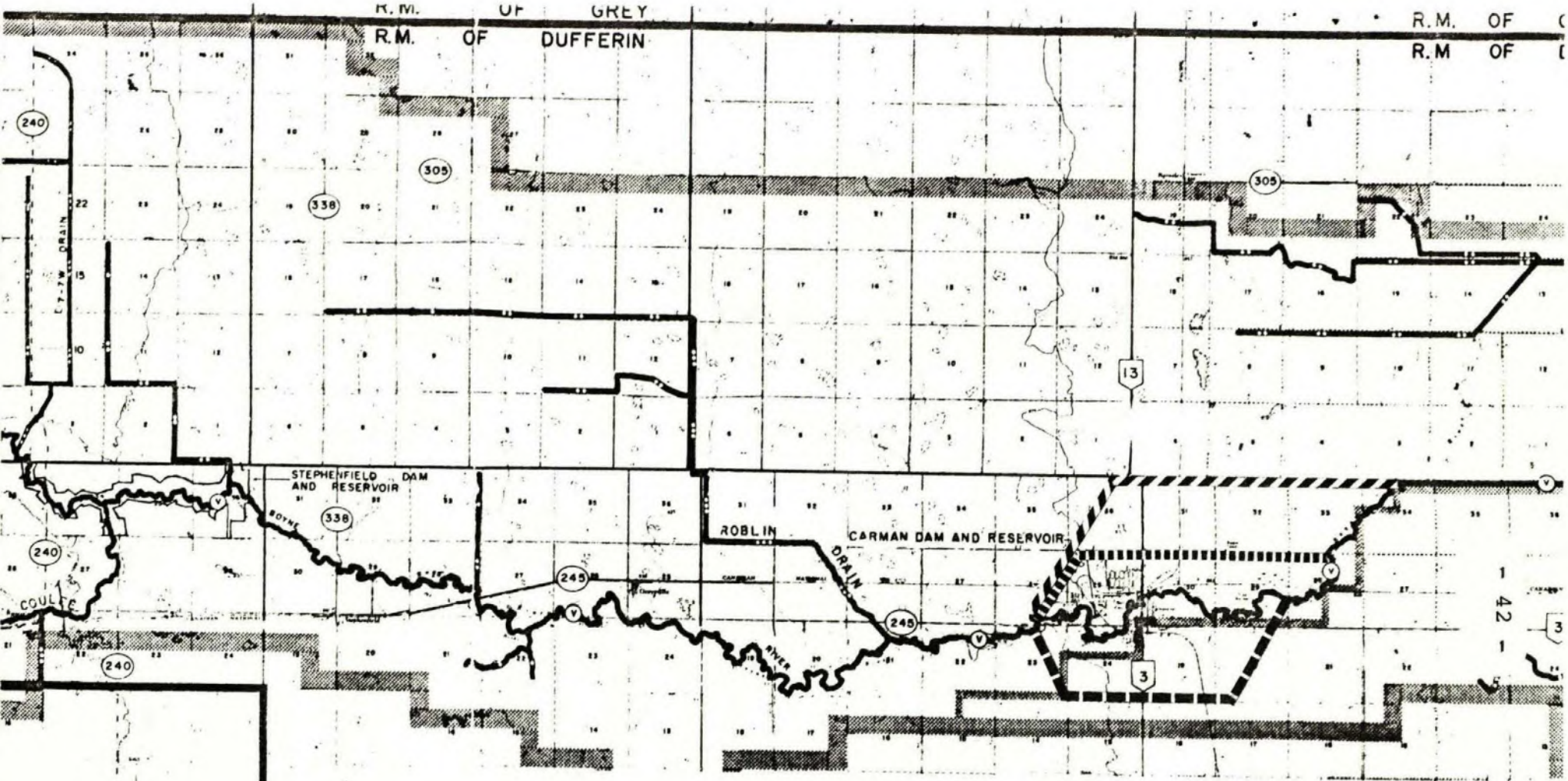

Figure 9: Alternative Diversion Routes

Alternative 1 ▰▰▰▰▰▰▰

Alternative 2 ▮▮▮▮▮▮▮▮▮▮▮▮▮

Alternative 3 ▬▬▬▬▬▬

Source: Benefit-cost Study of the Boyne River Diversion 1971

On the basis of additional information the flood frequency curve was calculated to show the 100-year flood as having a peak discharge of 8,400 cfs, up from 6,300 cfs of the earlier study. Once again the cause of the flood was attributed to a late spring thaw and high levels of precipitation prior to and during the melting period.(3)

No additional primary data was gathered in developing the analysis of the report. Consequently, many of the costs and benefits are updated figures based on the 1971 study. The alternative structural control considered included a diversion around Carman (based on the 1971 study, a diversion to Tobacco Creek, a diversion to the Assiniboine River at Rathwell, a channel improvement and dyking scheme, a headwater storage plan, a complete channelization program using retaining walls and an emergency dyking programs. Thus a wide range of alternative structural programs were considered. To develop benefit measures associated with flood control a new frequency damage curve was constructed. Damages were expanded to include the value of volunteer labour used to move property, fight the flood and assist in cleanup. For the 100-year flood the damage figure obtained in the 1971 study was adjusted to incorporate higher property values and additional development in the 100-year flood plain. Following this, annual expected benefits were calculated using the flood frequency damage curve. These were compared to the amortized costs of each structural measure to develop benefit-cost ratios, using a fifty-year projected life and a 10 percent discount rate. Table 9 presents the results of the evaluation of the various options. Two of the options were deemed to have such high costs that there was little point in completing detailed calculations. The diversion around Carman is Alternative 1 of the 1971 study. In the 1971 study this alternative had a benefit-cost ratio of 0.18 using a discount rate of 7.5 percent. In the 1974 study the benefit-cost ratio was 0.3 using a discount rate of 10.0 percent. This 66 percent increase in the benefit-cost ratio despite an increase in the discount rate which would act to reduce the ratio, ceteris paribus, indicates the increased value of the property in the flood hazard area. Although the emergency dyking has a benefit-cost ratio of 2.3 only small portions of the flood plain can be protected in such a manner. Thus annual benefits for this scheme are approximately one-third of those of the diversion around Carman.

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3. Planning Division, Water Resources Branch, Manitoba Department of Mines, Resources and Environmental Mananagement, Flood Reduction Alternatives for the Town of Carman, unpublished mimeo, Winnipeg, January 1975, p.4.

Table 9

Results of the 1975 Flood Reduction Alternatives Study in Dollars Per Year

	Annual Benefits	Annual Costs	Benefit-Cost Ratio
Diversion Around Carman	$107,000	$362,200	0.3
Diversion To Tobacco Creek	No Detailed Calculations Made		
Diversion To The Assiniboine At Rathwell	46,000	236,100	0.2
Channel Improvements & Dyking	101,500	339,500	0.3
Retaining Walls	101,500	380,200	0.3
Headwater Storage	No Detailed Calculations Made		
Emergency Dyking	36,000	15,500	2.3

In summary, the results of this second study indicate that under a more restrictive discount rate the benefit-cost ratio of the Carman diversion increased from the previous period. It also indicated that the only potentially viable way to deal with the flood problem in Carman involved dealing with the problem at Carman itself. Diversions to other basins or headwater storage schemes have costs at least an order of magnitude greater than the control methods that involve altering the river flow in the immediate vicinity of Carman which is why detailed calculations were not undertaken. In the conclusions of the study a recommendation was made that the Town and Rural Municipality should restrict development in the flood plain. Only development that did not impede the carrying capacity of the river should be allowed and any future development within the flood plain should be protected to the level of the 100-year flood.(4) To a certain extent this latter half of the recommendation is internally inconsistent. If any construction takes place in the flood plain it will impede the flow of the flood waters. The magnitude of this effect will depend on the quantity of construction and the type of flood-proofing

4. Ibid, p.34.

employed. If a pad is employed to elevate the building this will result in more water displacement and resistance to flow than if the building is elevated and internally flood-proofed. Fundamentally any construction in the flood plain will result in impediments to the river's flow. Thus to minimize the area inundated no construction should be allowed.

The study of the 1979 flood completed in January of 1981 differs considerably from the previous two. In the first place it was undertaken by both provincial and federal agencies giving it a broader focus of interest. More importantly it incorporates a significant extension in terms of methodology. The study recognizes that flood frequency damage curves as normally constructed are representative of a single point in time. The damage caused by a flood is conditioned by the value of the property at risk at the time of the flood. Where the value of the property changes over time then so must the flood frequency damage relationship. Thus, if the value of property is 50 percent higher five years in the future, then this growth in value must be incorporated in calculating expected annual damages from flooding. In the 1981 study this relationship was introduced by allowing annual benefits from a flood control structure to increase at some percentage over time.

In most other respects the study did not depart radically from procedures followed previously. No primary data was collected by the study team but they did make use of results assembled by local residents who were involved in trying to find a solution to flood hazard in Carman. Once again damages for the 100-year flood were obtained by adjusting the 1971 estimates to reflect changes in assessed values and new structures. The flood frequency curve was redeveloped with a flow of 7,000 cfs being the 100-year flood. Real discount rates of 5, 10 and 15 percent were employed, as suggested in Treasury Board guidelines. Four structural options were considered. These include the Alternative 1 diversion of the 1971 study, the Rathwell diversion into the Assiniboine, the channel improvement and dyking scheme, and the use of retaining walls.

Annual benefits and costs were calculated for each option using three different discount rates and three different growth rates for annual benefits from flood control. Thus each structural option is evaluated under nine different conditions. Table 10 presents the results using a 10 percent discount rate and no growth in annual benefits, while Table 11 presents similar results using a 10 percent discount rate and 1 percent annual growth in benefits. Table 10 is thus directly comparable to Table 9 and it can be seen that the benefit cost ratio has once again increased, by approximately 75 percent in this instance. Adding a 1 percent annual increase in benefits adds approximately 11 percent to the benefit-cost ratios.

Table 10

Annual Benefits and Costs or Alternative Flood Control Measures Using a 10 Percent Discount Rate and 0 percent Increase in Annual Benefits

	Annual Benefits	Annual Costs	Benefit Cost Ratio
Diversion Around Carman	$357,700	$674,900	0.53
Rathwell Diversion	153,800	439,400	0.35
Channel Improvement & Dyking	280,600	668,000	0.42
Retaining Walls	280,600	758,400	0.37

Source: 1981 Report.

Table 11

Annual Benefits and Costs for Alternative Flood Control Measures Using a 10 Percent Discount Rate and 1 Percent Inrease in Annual Benefits

	Annual Benefits	Annual Costs	Benefit Cost Ratio
Diversion Around Carman	$398,200	$674,900	0.59
Rathwell Diversion	171,400	439,400	0.39
Channel Improvement & Dyking	307,300	668,000	0.46
Retaining Walls	310,900	758,400	0.41

Source: 1981 Report.

A further innovation of the 1981 report was the introduction of additional flood costs, in particular the necessity of evacuating residents of senior citizen homes and housing them in other communities. Other costs were consistent with the categories established in the previous studies. If a 5 percent discount rate is employed the 1981 task force found that with a 1 percent increase in annual benefits the benefit-cost ratios for the diversion around Carman became 1.08 indicating that the net present value of benefits exceeds the net present value of the stream of costs.

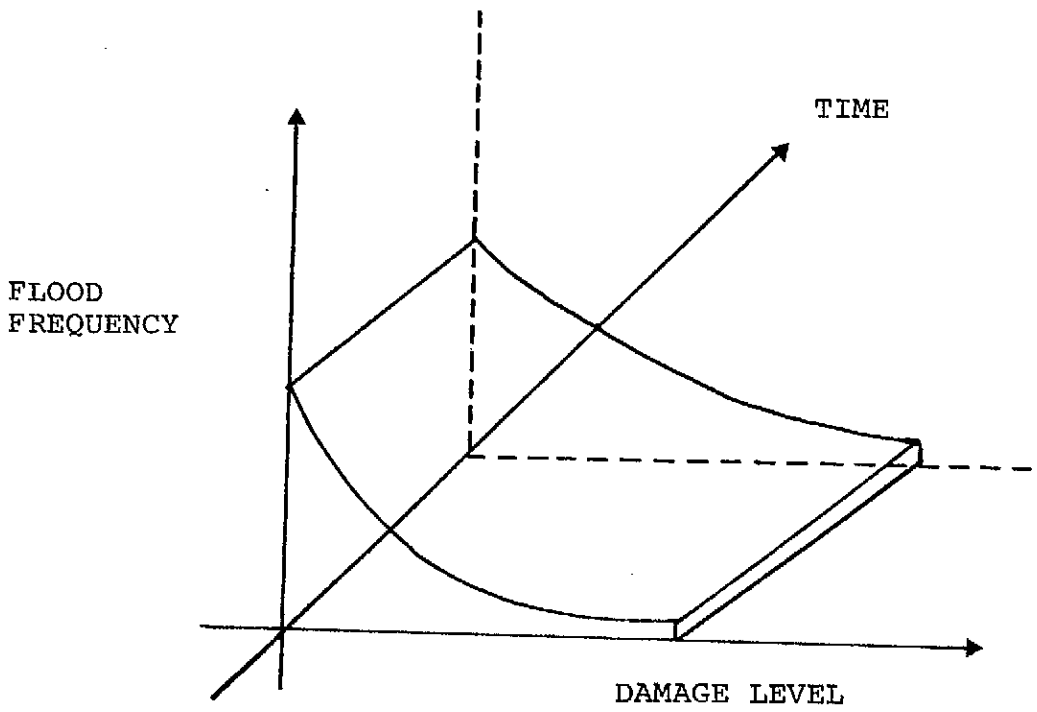
In summary, while none of the previous studies indicate that the benefits from providing structural assistance to Carman exceed the costs, using the discount rates required for federal projects at the time of the respective studies, they do indicate that over time the benefits are increasing faster than the costs. This is an important point because it indicates that despite major floods which have occurred close together in time the value of the property subject to damage in the flood hazard area has increased rapidly. Clearly the knowledge that a major portion of Carman is a flood hazard area must have an adverse effect on decisions to invest in the town. Yet we are observing fairly rapid increases in the value of assets in the flood plain area. Surely this indicates that in the evaluation of private investors the dangers of flooding are offset by the economic benefits of the location. Economic growth continues to take place in the flood plain because Carman presents business opportunities that cannot be readily captured from another location.

The methodology for analyzing the benefits associated with a flood control structure are rather imprecise. Benefits consist of prevented damages. Thus to measure benefits one must compute the probability of various floods and the damages that would be associated with them.

Expected benefits from flood hazard abatement are developed from a flood frequency-damage curve which relates floods at varying probabilities or magnitudes to the damages that can be expected with each flood. Thus, a continuous function relating changing damages and changing flood probabilities can be developed. This function indicates damages associated with varying floods for a given level of development and inventory of assets in the flooded area. Thus if the stock of assets changes, a new frequency-damage curve is required. Over time if the value of the asset base in the community changes then a flood probability-damage surface is required. Figure 10 sketches such a surface. For floods of

Figure 10

Conceptual Diagram of a Frequency-Damage Surface



a given magnitude the associated damage depends on the time period in which they occur. Unfortunately it is very difficult to develop an accurate frequency-damage curve so estimation of the relevant surface that generated the curve for a particular point in time is impossible in practice.

Current engineering practice is to develop a smooth curve relating flood frequency and damage by assembling data on damages associated with the most recent flood, and its related frequency. This gives damage levels associated with the existing level of development. This damage level is then used to infer damages that would be associated with the 100-year flood, giving a second point. A third point is developed by determining the frequency at which channel capacity is exceeded. These three points are then used to construct the curve. Any error in estimating damages or frequencies will result in a curve that is incorrect. Similarly if damages are not a smooth function of flood levels the curve is inappropriate. Further, the curve uses actual damages associated with the most recent flood when potential damages are the relevant consideration. Finally, unless a detailed hydrologic study of the extent of the 100-year flood is conducted and an inventory of the property in that 100-year flood plain is undertaken the guess at damages associated with the 100-year flood cannot be accepted with great certainty.

Given the above it is important that sensitivity of benefit-cost ratios to changes in the frequency damage curve be undertaken. In addition, it is important to incorporate any changes in the value of the property being protected into the analysis or the benefit-cost ratio will be incorrect. The conventional methodology once the frequency-damage curve is developed is to calculate an expected damage level which summarizes the information contained in the curve. Expected damages are calculated by determining the area under the frequency-damage curve which gives total expected damages over 100 years. This value is divided by 100 to obtain annual expected damages. Expected damages will be sensitive to the accuracy of the curve at any point in time, and selecting the correct curve for each point in time. If one is willing to assume the frequency-damage curve shifts a constant proportion over time then the way to incorporate changes over time is to include a percentage adjustment in the expected annual damage level in each year over the life of the project. To deal with errors in the baseline frequency-damage curve one can adjust the initial annual expected damage value.

In order to test the sensitivity of these results to variations in the underlying assumptions three new frequency-damage curves were developed. In all cases the flood frequency-damage curve developed in the 1981 Ad Hoc Task Force report is the standard for comparison since it represents the most recent calculation. The various assumptions are stated below and the new frequency-damage curves are produced as Figures 11, 12, and 13. Table 12 presents the assumptions of the 1981 report and the three adjustments.

Case 1 (Figure 11) assumes that existing measures of flood damage associated with the 1979 flood understated damages by $900,000. This increase reflects uncounted or understated actual damage and the inclusion of potential damages. It can be argued that potential, not actual damages, should be used in developing the flood frequency-damage curve since one is trying to measure the true value of the area to be protected. Actual damages reflect a residual value after significant flood damage reduction activities have been undertaken, such as removal of personal property or relocation to a higher floor. Consequently, actual damages understate potential damages. These measures are really alternatives to a structural protection scheme and should not be considered in evaluating benefits and costs associated with structural measures. Conceptually actual damages are floor values for potential damages with the two values being equal if the flood arrives before any damage reduction activity can be carried out. Similarly, as the damage associated with the 1 percent flood is derived from the damage estimates for the most recent flood the damage level associated with this 100-year flood was also increased by a proportionate amount to reflect undercounting.

The result of this increase was to shift the frequency-damage curve to the right for all levels of flooding. Thus for a flood of any given magnitude the associated damage level is higher with the new assumptions than the original assumptions of the Ad Hoc Task Force. Average annual expected damages prevented by a diversion associated with the new assumptions are estimated to be $528,000 if no flood protection is undertaken.

The second case studied (Figure 12) involved just increasing the damages associated with the 100-year flood while continuing to use the level of damages estimated by the Ad Hoc Task Force for the 1979 flood. The effect of this assumption was to shift the lower end of the damage curve to the right. Very high discharge floods of the 1 or 2 percent frequency have not been observed in Carman and even if one was to assume damages estimated from observed

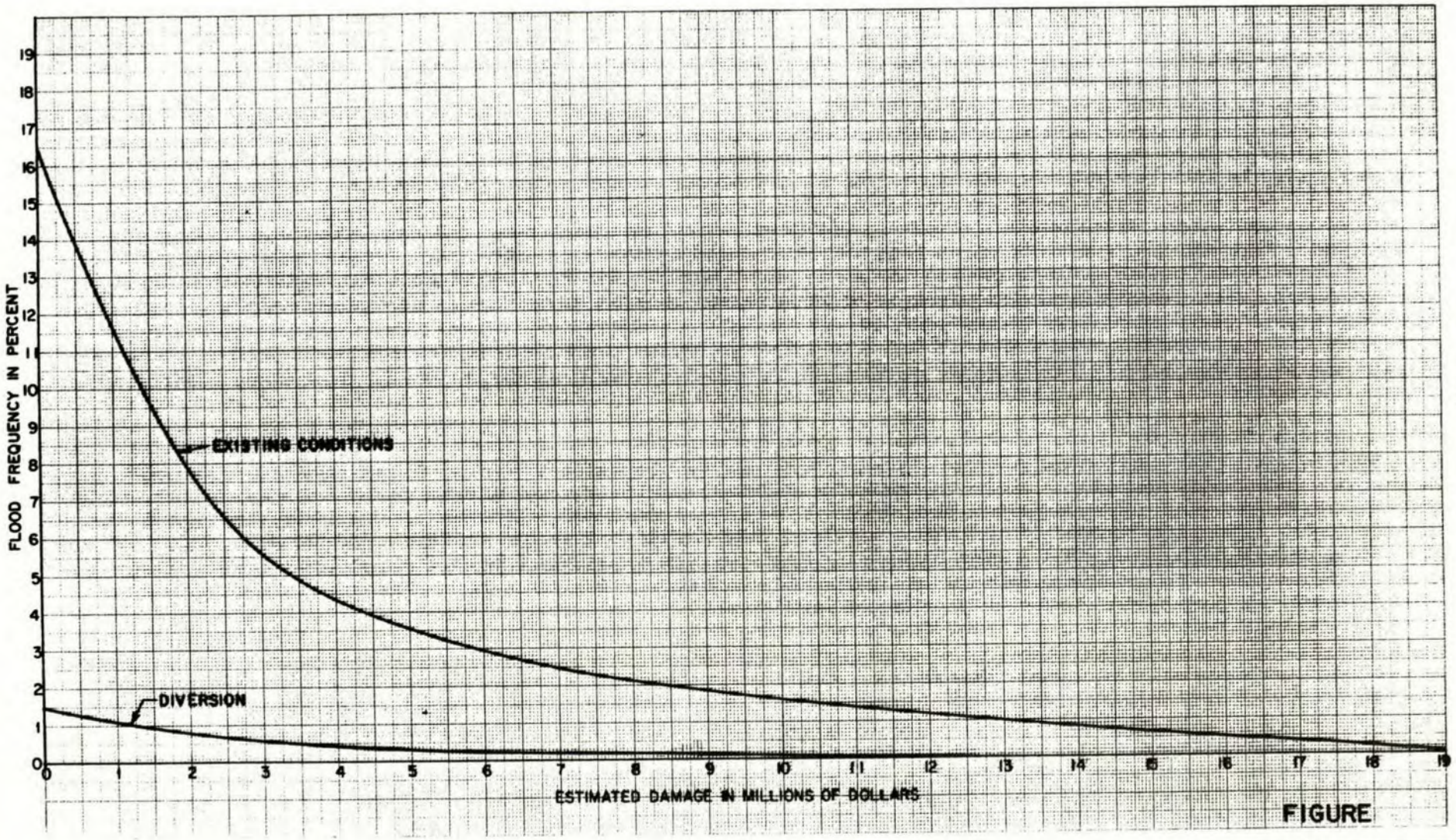


Figure 11: CASE 1 - Existing Probability With Higher Damages for 1979 and 1:100 Floods

CARMAN FREQUENCY - DAMAGE CURVES

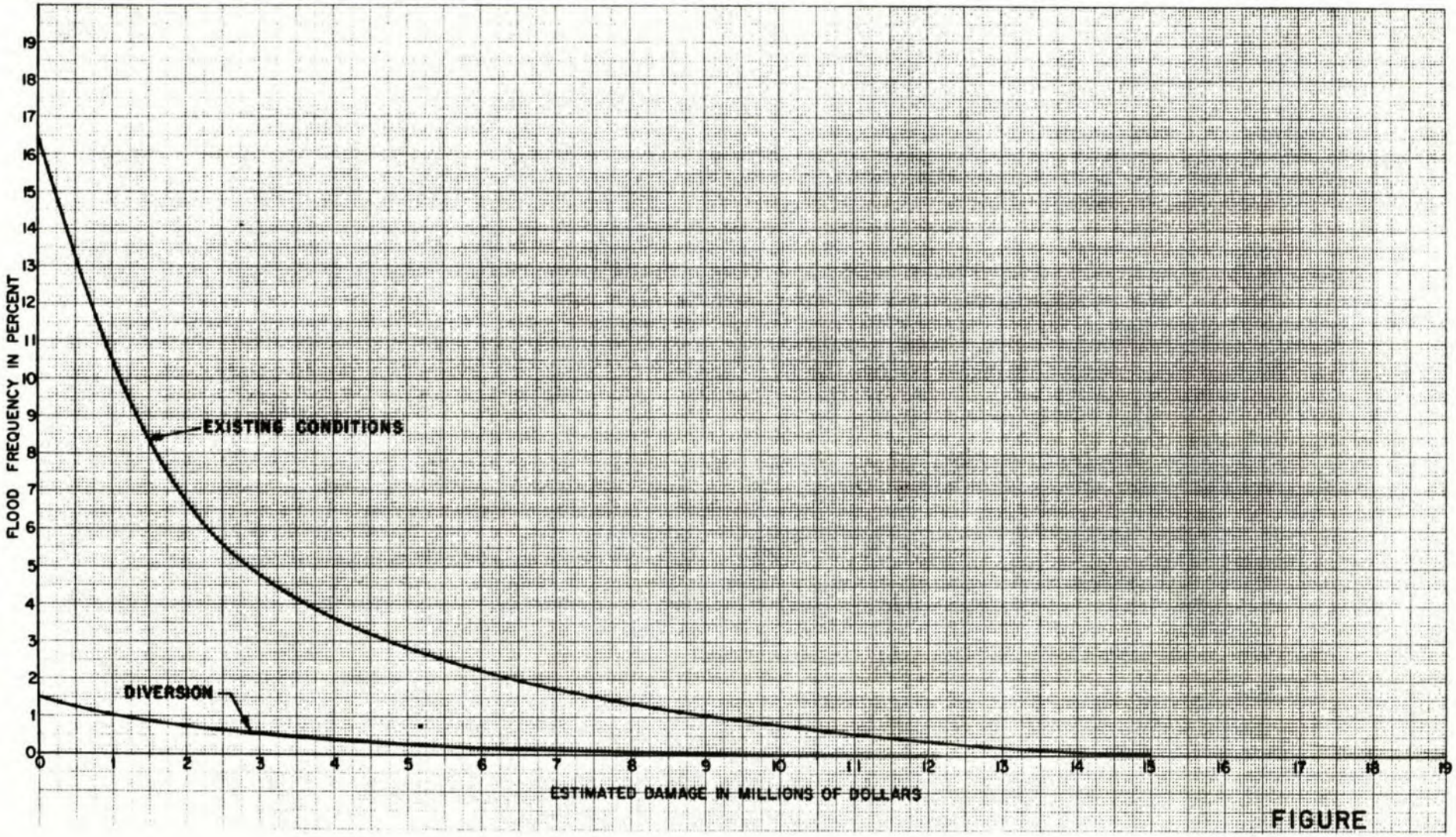


Figure 12: CASE 2 - Existing Probabilities With Higher Damages for 1:100 Flood

CARMAN FREQUENCY - DAMAGE CURVES

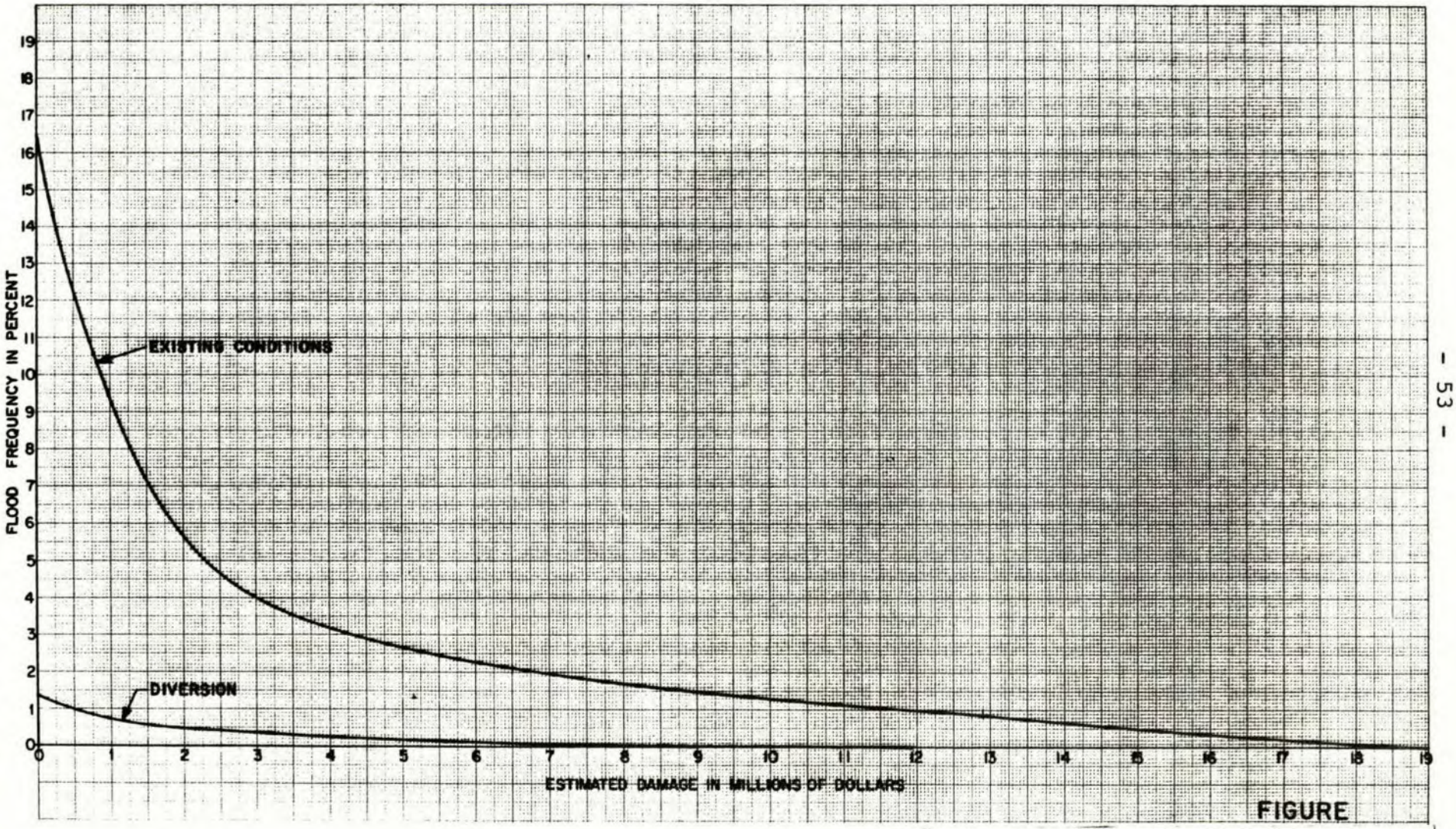


Figure 13: CASE 3 - Increased Flood Probability With Existing Damage Levels

Table 12

Various Assumptions Underlying Frequency-Damage Curves for Carman in 1981 Dollars*

	1981 Ad Hoc Task Force	Case 1	Case 2	Case 3
Bank Over-topping	16.5%	16.5%	16.5%	16.5%
1979 Flood Probability	5.5%	5.5%	5.5%	6.5%
1979 Flood Damages	$2.1 M	$3.0 M	$2.1 M	$2.1 M
100-Year Flood Damages	$9.0 M	$12.9 M	$12.9 M	$9.0 M

* No growth in value of property.

Table 13

Net Present Values of Reduced Expected Flood Damages Associated With Various Flood Frequency-Damage Curves for Selected Interest Rates and a Fifty-Year Time Horizon in 1981 Dollars**

Discount Rates	Ad Hoc Task Force	Case 1	Case 2	Case 3
	$ (357,700)*	$ (528,000)*	$ (435,000)*	$ (400,500)*
5.0%	6,530,000	9,639,000	7,941,000	7,311,000
7.5%	4,641,000	6,851,000	5,644,000	5,196,000
10.0%	3,547,000	5,235,000	4,313,000	3,971,000

** No growth in value of property.

* Figures in brackets are the annual expected damage levels for each curve.

floods were accurate measures of true damages there would still be reason to adjust damage levels associated with major floods. This procedure is amalogous to making use of the information contained in the confidence intervals given in the flood frequency curves. The effect of this assumption was to increase estimated average annual flood damage reduction benefits of the diversion to $435,600.

The final assumption presented as Case 3 (Figure 13) involves retaining the damage levels developed by the Ad Hoc Task Force but assuming that the flood of 1979 was a 6.5 percent flood rather than a 5.5 percent flood. Thus instead of the 1979 flood having a recurrence period of 18 years it can be expected every 15 years. The effect of this assumption is to shift the centre of the frequency-damage curve up slightly indicating that flooding, particularly medium-size floods occur with greater frequency than the Ad Hoc Task Force assumed. The effect of this change is to increase annual expected damage reduction to $400,500.

All the assumptions made in the three sensitivity tests are hypothetical. They are, however, not unrealistic. Given the limited information available for the construction of flood frequency-damage relationships any of the three cases presented above could be reasonable approximations of the actual conditions, as could the curve calculated in the Ad Hoc Task Force report. The crucial element to understand is that a frequency-damage curve represents conditions at a point in time, both in terms of levels of development in the flood hazard area and in terms of the hydrology of the river itself. The accuracy of the knowledge concerning this information determines the validity of the frequency-damage curve developed from it. The major shifts in expected annual damages, associated with each of the three cases, from the figure of $357,700 presented in the Ad Hoc Task Force show that minor adjustments in the underlying assumptions produce significant adjustments in the final result.

Table 13 presents net present values associated with each of the three alternatives presented above and the Ad Hoc Task Force annual expected damage reduction figure. It can be seen that the variability in the assumptions regarding flood damage and probability induce a level of variability in the present values similar in magnitude to variability in discount rates. This is a crucial observation because it shows that the results of the analysis are very sensitive to the assumptions used in generating the frequency-damage curve. Furthermore, the degree of sensitivity of the results appears to be of the same relative order as changes in discount rates. The analysis conducted above does show

that even taking into account possible understatement of flood damage reduction benefits the conclusions drawn by the previous studies that the Carman diversion cannot be justified on economic grounds still hold. Although in principle such sensitivity tests should become part of benefit-cost analysis for flood damage control projects, in this case the conclusions were not altered.

H. CANADA-MANITOBA FLOOD DAMAGE REDUCTION AGREEMENT

The Canada-Manitoba Flood Damage Reduction Agreement came into effect on December 20, 1976 as a mechanism to regulate development in flood-prone areas, thereby reducing flood control, flood fighting and flood disaster relief expenditures which "... represent an unwarranted income transfer from the public at large to those receiving the benefit of such measures ..."(5) The Agreement is designed to limit development in areas that are designated as flood risk areas by each government agreeing to the use of the following means:

> "(i) its departments and agencies do not engage in any further undertakings in the designated areas which are vulnerable to flood damage; and
>
> (ii) its programmes of financial assistance to third parties are administered so that no assistance is given to any further undertakings in the designated areas which are vulnerable to flood damage, and without limiting the generality of the foregoing.
>
> (a) the Department of Regional Economic Expansion will not grant a development incentive or a loan guarantee under the Regional Development Incentives Act with respect to a facility that is or is to be located in the designated area, and that is vulnerable to flood damage; and
>
> (b) the Central Mortgage and Housing Corporation will not extend financial assistance, whether by loan, contribution, guarantee, insurance or otherwise, under the National Housing Act with respect to any further undertaking in the designated area that are vulnerable to flood damage; and

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5. Canada-Manitoba Flood Damage Reduction Agreement, Government of Canada Order in Council 1976-411753, Province of Manitoba Order in Council 1129176, December 20, 1976, mimeo, p.1.

(b) each Party shall, subject to sub-clause (2):

(i) encourage the zoning authorities under its legislative jurisdiction to impose zoning restrictions that will prohibit or, where appropriate, make subject to requirements for adequate flood proofing all further undertakings in the designated area that are vulnerable to flood damage; and

(ii) ensure that where zoning restrictions as described in sub-paragraph (i) are imposed, its departments and agencies comply therewith."(6)

It is clear from the above quotation that the intent of the Agreement is to preclude all non-agricultural or non-recreational uses of designated land. Exemptions are made in cases where either structures are adequately flood-proofed or the entire area is protected by a structural device.

The intent of the legislation is made clear in the section of the General Agreement titled "Basic Approach for Reducing Potential Flood Damage":

"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 non-structural alternatives, including the alternative of allowing some flooding to occur, so that the best choice on the basis of effectiveness, cost, 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."(7)

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6. Ibid, p.4.

7. Ibid, p.3.

Thus in situations where the property in the flood plain is of sufficient value to justify structural measures such as dams or diversions these methods may be employed. The critical criterion for evaluating what to do with an area once it has been identified as a flood risk area is a benefit-cost analysis of all practical alternatives. This is consistent with the general aim of minimizing unwarranted transfers from the public at large to flood plain occupants.

The procedure by which an area becomes designated is lengthy. The initial step is to map the area that is deemed to have a flood hazard risk. This mapping is designed to set out the area subject to inundation by the 100-year flood at the minimum and to provide information to the public and the agencies responsible for designating an area as being subject to flood hazard. The maps produced are reviewed by a technical committee who advise the provincial and federal governments whether an area should be designated on an interim basis if there is some doubt as to whether the area considered meets all the criteria for designation, or designated if all criteria are met. The primary difference between designation and interim designation is that in the latter case local authorities are not asked to zone the area to preclude activities that are subject to flood damage. In either case both the federal and provincial governments agree not to invest any funds in the designated area, either directly or indirectly, where the purpose of those funds involves construction that is subject to flood hazard.

If a structural measure is constructed that removes the threat of flood hazard the designation is removed. Prior to the construction of such structural measures a benefit-cost study must be undertaken to ascertain if the benefits associated with the structure exceed the costs. In the case of Carman the town is scheduled for designation and three previous benefit-cost studies have indicated that structural protection could not be justified. There are, however, grounds to argue that with designation sufficient change will take place in the institutional structure affecting the town that the results of these previous studies are not applicable to the new situation. The remainder of the report discusses in greater detail the arguments underlying this claim.

I. FUTURE DEVELOPMENT IN CARMAN

Future developments in Carman will depend primarily on the impact of designation on the town. The process of designation by precluding continuation of the status quo will force the town to make major changes in the patterns of land use, unless a diversion is built. Figure 14 presents the general land use pattern of the town at present. Superimposed on the map are the boundaries of the 100-year flood plain. Virtually all of the commercial district, particularly the consumer service sector, is located in the flood plain, as are approximately one-third of the housing units, the town hall, the hospital, public school and most of the churches. Interviews with a cross-section of the proprietors of commercial establishments resulted in a uniform concern with flood hazard. In approximately half the cases of those firms located in the flood plain the operator indicated a desire to relocate. Even those wishing to remain in the core of the town were concerned about the profitability of expenditures on improving or maintaining their property. In a number of cases individuals felt that designation would result in a fairly rapid exodus of commercial establishments from the area. This exodus would be most rapid for national corporations that have policies precluding subjecting employees and facilities to unnecessary hazards, and the financial resources to effect a speedy relocation. Local companies would be less likely to move because of limited resources.

Given existing land use patterns, relocation of the commercial sectors would have to occur beyond existing town boundaries, probably north or south on Highway 13. This would require further extension of the town boundaries into the rural municipality and major expenditures on infrastructure by government, as well as the direct costs of establishing new buildings. The result would be a community with a decaying central core and a widely dispersed commercial district.

Current sewer and water service lines are shown on Figure 15. Expansion into new areas will require major expenditures particularly for sewage lines. The current system cannot be extended to the north or south without the construction of a lift station. In a 1979 engineering study by Underwood MacLellan the cost of a lift station and associated force mains for either the north or south end of town was in the neighborhood of $200,000. Additional expenses for water and sewer mains brought municipal servicing costs to $5,000 per acre.(8)

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8. Underwood McLellan, "Draft Report on Services for Proposed Annexation Areas, Town of Carman", Unpublished mimeo, August 1979, p.20.

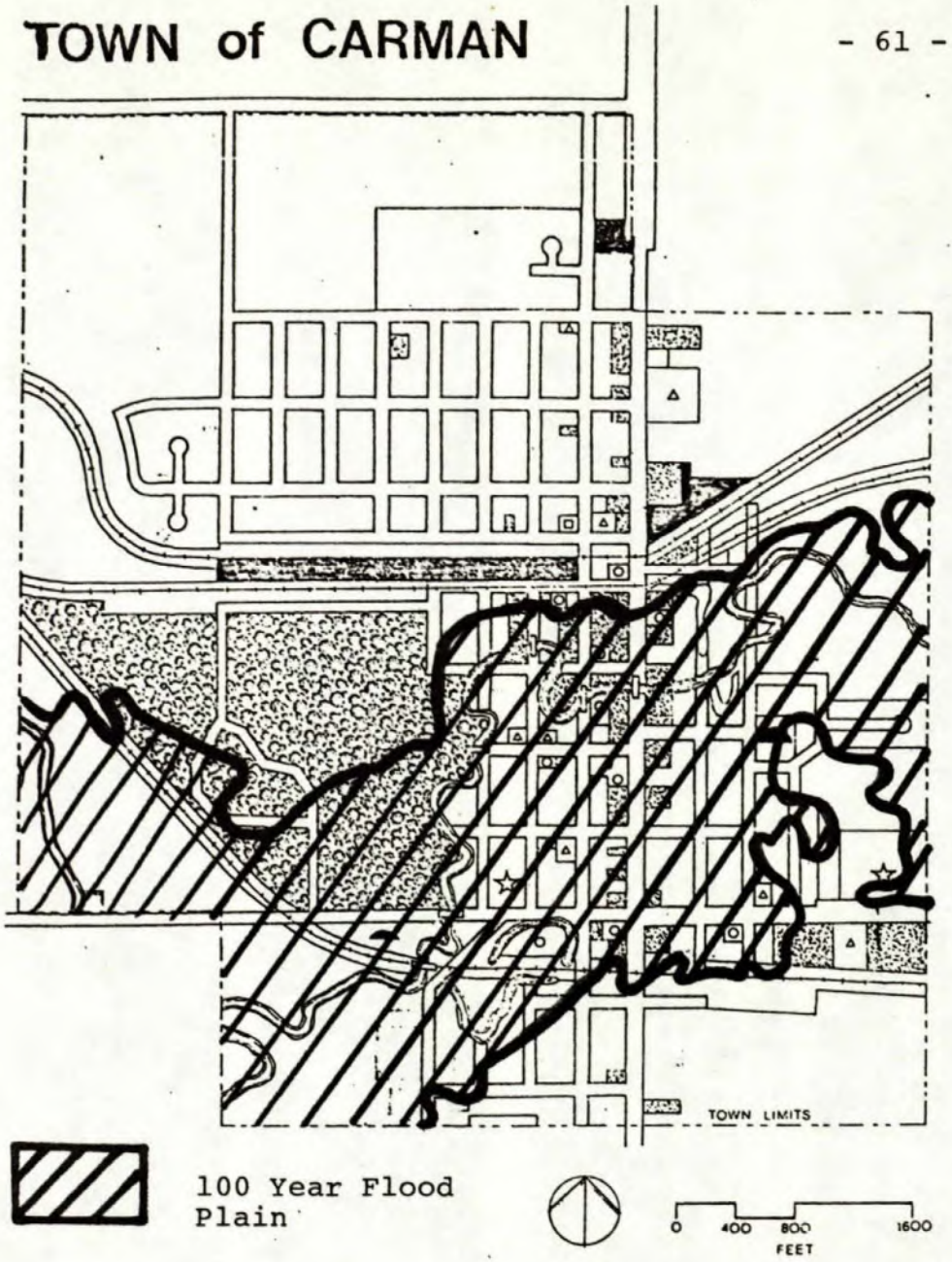
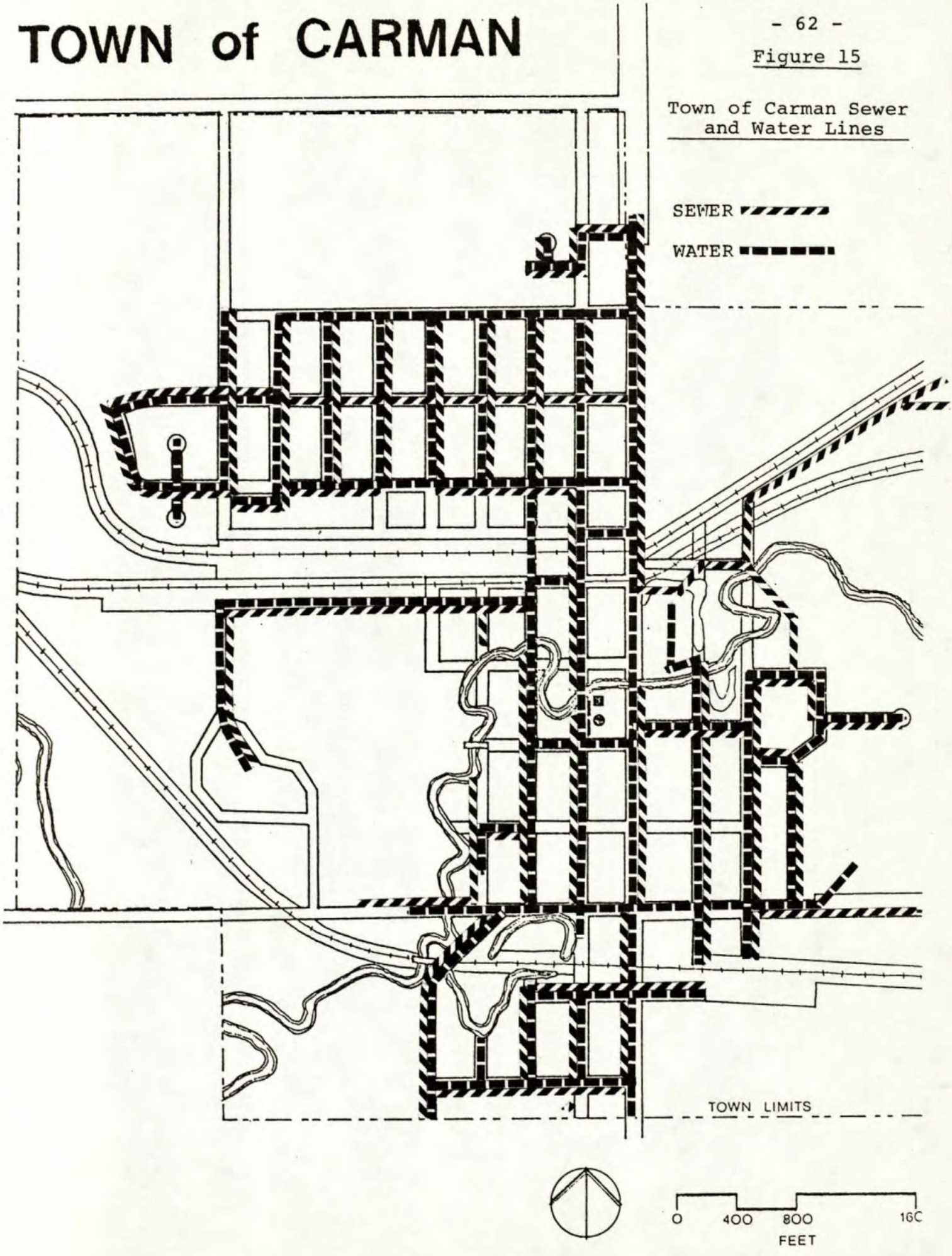

TOWN of CARMAN
TOWN LIMITS
100 Year Flood Plain
0 400 800 1600
FEET
LAND USE
CHURCH
CIVIC
TOWN HALL
SCHOOL
HOSPITAL
CARE HOME
LEGION
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
RECREATIONAL
VACANT

Figure 14

Figure 15

Town of Carman Sewer and Water Lines



Current assessed value of residential property in the designated flood plain is $2,125,290.(9) Using a ratio of assessed value to market value of 14 percent, this gives a market value of $15,180,643. In 1979 Carman's total taxable assessment was $5,841,380 which results in a proportion of residential flood plain property to the total of 36 percent. Clearly designation will have a major impact on the market value of this property. Local realtors indicated they expect designation to result in an immediate 20 percent decline in market values. From society's point of view this decline is primarily a windfall loss to individual property owners and can be thought of as a transfer. However, this is also an indicator of a true social cost brought about by the difficulty in arranging financing for restoration or purchase of housing in the flood plain. Rather than housing being maintained in a manner to ensure a long life it will be rapidly depreciated. The result is a far shorter life and the need to allocate resources to construct new homes well before the time they would otherwise need replacing. Rather than existing homes being upgraded, new homes will need to be constructed at far higher costs. Thus the effect of designation will be to bring about social costs in terms of the need to develop more building sites outside the flood plain and construct more houses.

The average home in the flood plain is 25 years old and could be expected to have a life span of 85 years. Designation could easily reduce this life span by 20 percent to 68 years. In terms of number of homes removed per year one could reasonably project that on average seven residences will be lost per year that with a diversion would remain viable housing units.

Analysis of building permits issued over the 1970-81 period shows that the bulk of new construction has taken place outside the flood plain. However, major expenditures on new construction continue to occur within the flood plain particularly for non-residential use. This pattern can be explained by the limited number of vacant residential lots in the flood plain area and the current technology of housing development through sub-divisions. It is instructive to note that major new investments were made in the flood plain following the 1970 and 1979 floods. Peaks and troughs in building activity, within and outside the flood plain, although not completely in harmony, indicate that new construction takes place in cycles that are determined by forces other than flood hazard. Thus major exodus from the flood plain, as would be indicated by large jumps in the value of building permits following a flood, does not appear. On average the value of permits issued within and outside the flood plain move in the same direction. Table 14 and Figures 16, 17, and 18 present the relevant information on the value of building permits issued.

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9. Calculated from Town of Carman assessment records.

Figure 16

Total Value of Permits Issued 1970 - 1982

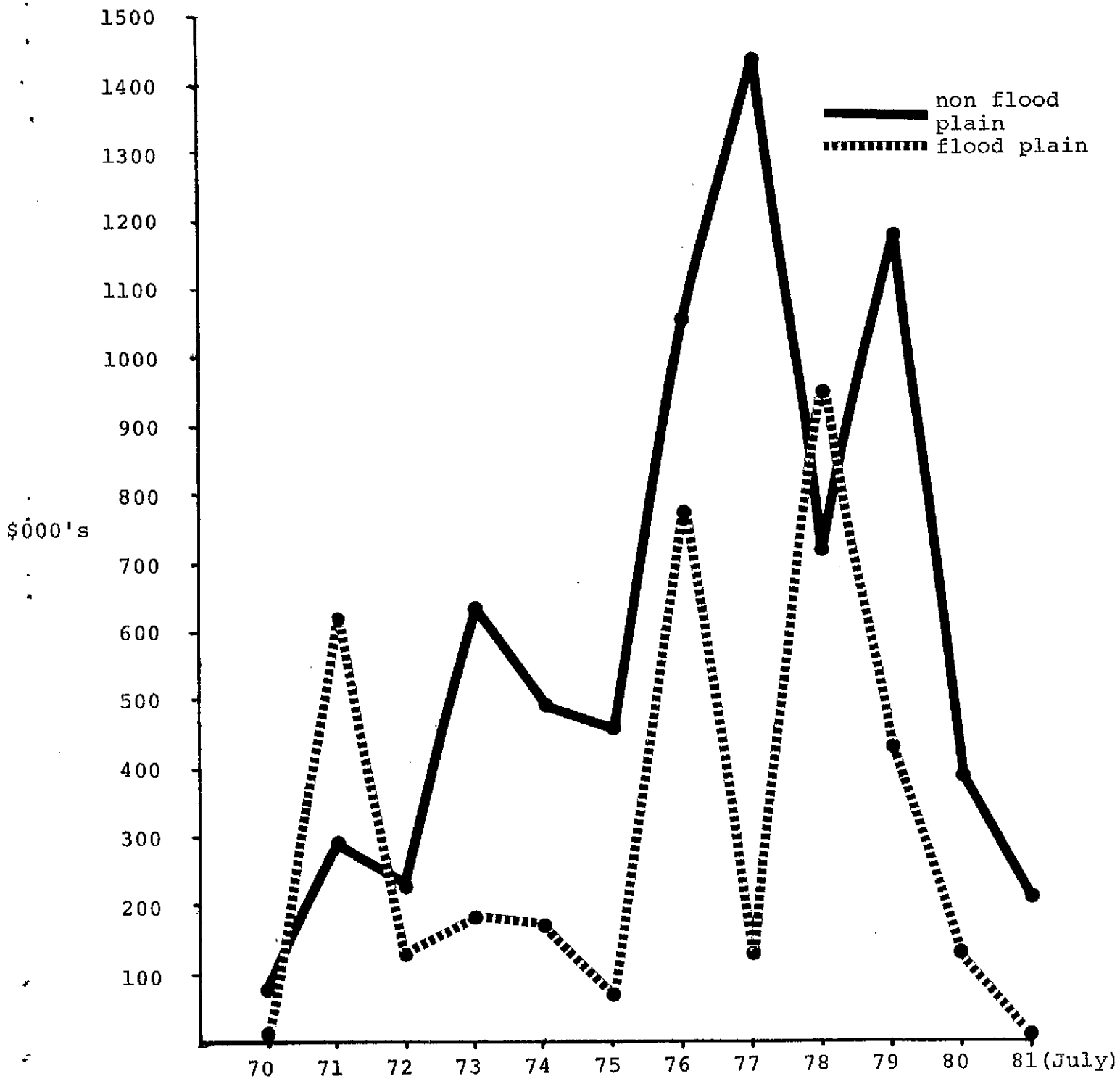

Figure 17

Residential Building Permits Issued
1970 - 1981

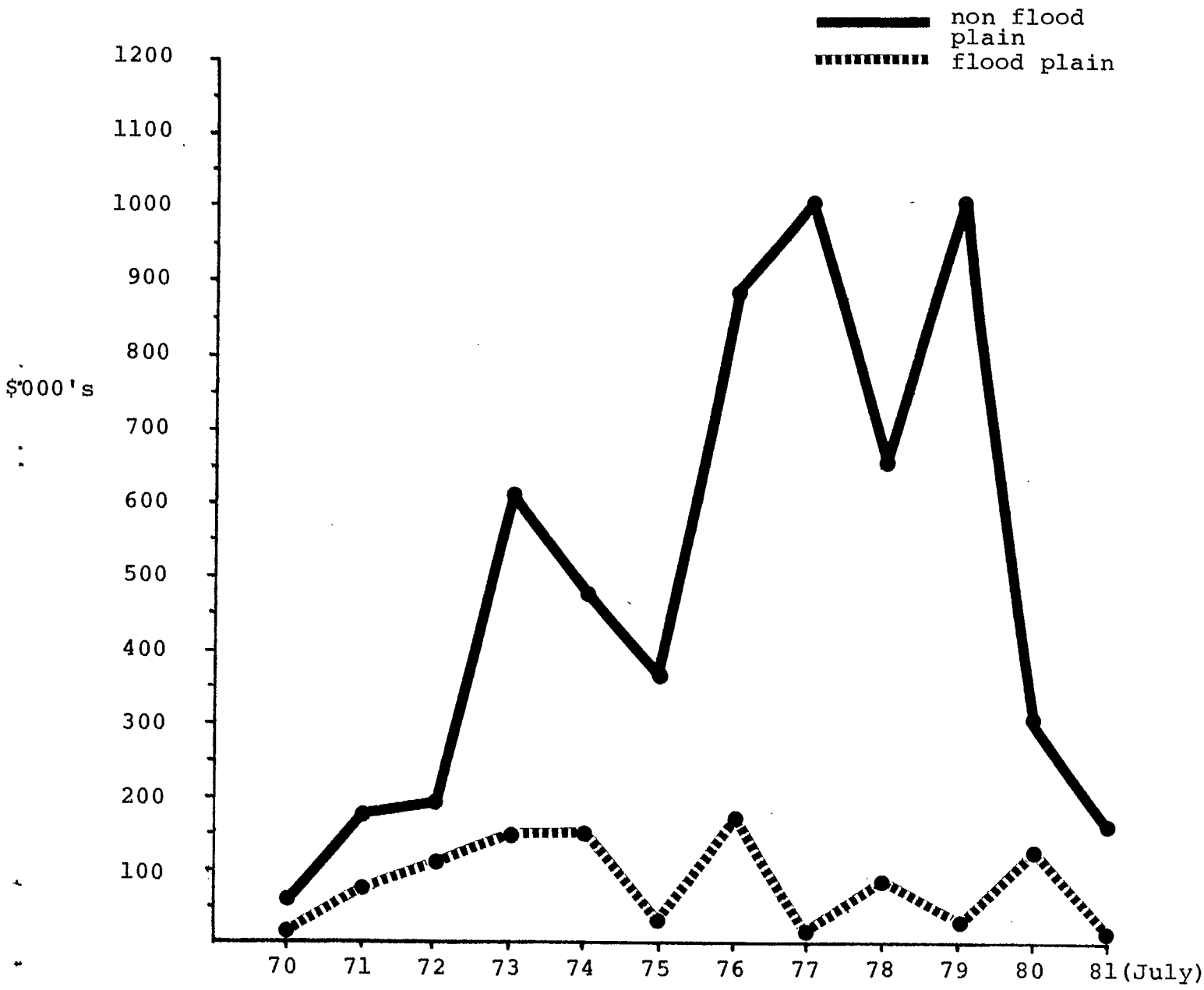

Figure 18

Non-Residential Building Permits Issued
1970 - 1981

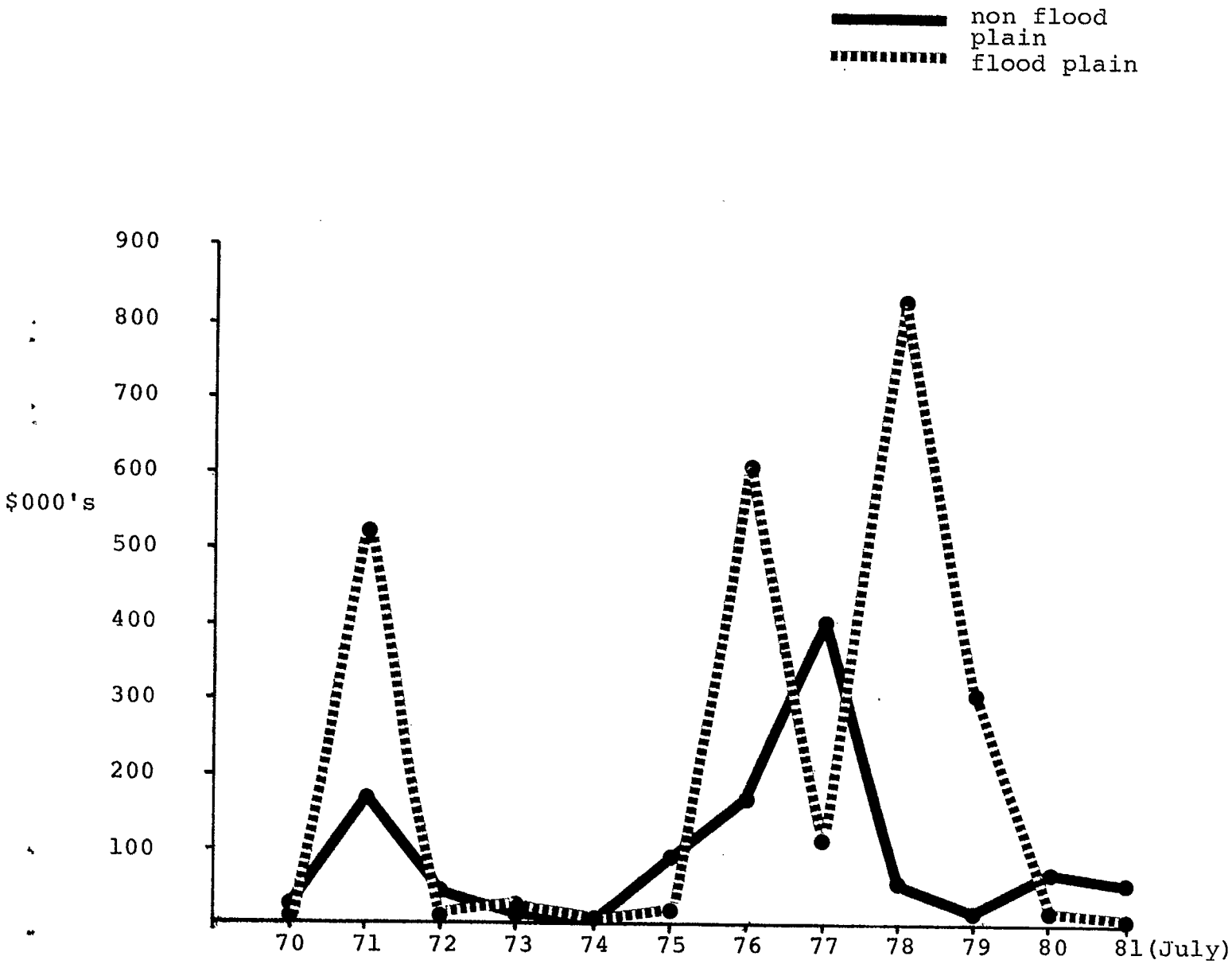

Table 14

Town of Carman
Building Permits Issued
1970 - 1981

	Flood Plain			Non-Flood Plain		
Year	Residential	Non-Residential	Total	Residential	Non-Residential	Total
1970	4,400	--	4,400	54,000	19,200	73,200
1971	82,750	533,135	615,885	172,400	174,750	347,150
1972	118,950	6,500	125,450	193,800	41,500	235,300
1973	150,500	37,750	188,300	610,426	27,250	637,676
1974	149,500	14,000	163,500	484,600	11,000	495,600
1975	35,000	24,400	59,400	368,700	91,800	460,500
1976	161,100	621,300	782,400	890,200	169,000	1,059,200
1977	19,200	109,763	128,963	1,035,876	405,000	1,440,876
1978	93,898	843,500	937,398	662,360	58,000	720,360
1979	37,000	352,329	389,329	1,155,250	18,400	1,173,650
1980	127,500	7,000	134,500	325,500	69,400	394,900
1981*	4,000	--	4,000	167,350	55,000	222,350

* Figures calculated from January to July, 1981.

In addition to the obvious expense of relocating private property such as homes and commercial establishments, there are the costs of relocating public buildings. Currently a new hospital is being constructed because of the fear of flooding at the old site. Had flood hazard not been at issue, an addition to the existing structure could have been undertaken at far lower costs. Currently no definite plans are being made for the use of the old building after the new hospital is constructed, primarily because of its flood susceptibility. This is an example of a major cost to society which could have been avoided had a diversion been in place. Not only could the incremental cost of going from an addition to an entire new hospital been avoided, so could the costs of scrapping the existing building. A similar case will arise when work needs to be performed on the public school or the town hall. Neither the provincial nor federal governments can advance any money for improvements to these facilities under the terms of the Flood Damage Reduction Agreement. Consequently the only alternative is a new facility located outside the flood plain, which implies far higher costs to both local residents and the senior levels of government.

Development patterns in Carman are at an important threshhold. Following designation major adjustments will be made. Two cases are possible. One involves construction of a floodway to protect the town, the other leaves the town to adjust to the restrictions imposed by designation. As noted above designation as a flood hazard area imposes major adjustments on the town residents as individuals and as a local government.

Currently Carman is faced with a limited number of sites for additional commercial development within the town centre and a shortage of rental housing. These two problems are the most serious elements influencing future development. Whether the town obtains a diversion or not will have an important influence on the pattern of development. Without a diversion all future development will take place north and south of the designated flood plain area. This will result in a sprawling pattern that imposes higher costs for residents and local government. Costs of providing local services will increase, consequently tax rates will increase and/or the quality of services will decline. In addition residents face additional costs involved in commuting to stores, schools, churches and recreational facilities. With a diversion, although some development may be required beyond current boundaries, there is the ability to use already serviced land and to increase densities of use in the core area. This would lead to a more compact development pattern with lower costs for both the residents and the town government.

As argued previously, designation of Carman as a flood hazard community imposes major changes on the town. By designating the segment of the town within the 100-year flood plain as being ineligible for provincial or federal financial assistance unless any structure is protected to the level of the 100-year flood a major shift in property rights has taken place. Structures within the flood plain are now treated differently from those outside the designated boundary. A property owner within the flood plain has far more restrictions on what are viable uses of the land. It becomes harder to arrange financing for any project even if the owner is willing to absorb the costs associated with flood hazard because provincial and federal financial assistance is restricted. In a legal sense designation of a community as being subject to flood hazard results in a taking of property rights by a higher level of government, by the application of that government's police power. Although these rights are valuable no compensation is paid to the individuals losing them because the taking is not of the land itself but of the ability to use the land for certain purposes. In the former case compensation would be required because title to the land would change. In the latter case no title changes take place so no compensation occurs.

From an economic perspective the decision to regulate through designation is justifiable if the benefits from restricting use of the land, either directly or indirectly exceed the costs. Thus the argument for limiting use of the flood plain is that society escapes having the burden of flood damage to property and the transfer payments that arise in the provision of disaster assistance to flood victims. By restricting use of the flood plain society gives up these potential costs but at the same time also foregoes the benefits associated with use of the flood plain in non-flood years. Where alternate sites can be found to set up precluded uses at costs comparable to sites which have potential to be inundated, the net benefit to society from restricting use of the flood plain will be significant. Where the costs of using flood-free land are high in terms of relocation or lower suitability for particular uses, then precluding particular uses may result in greater costs to society over the long run than providing infrequent flood assistance.

In the case of Carman the costs of designation include the following considerations:

(a) Increased costs associated with developing land for commercial, residential and industrial uses beyond the existing limits earlier than would be necessary and in greater quantities than would otherwise be necessary.

(b) Increased costs for residents as a result of a less compact development pattern which includes commuting to stores, friend's homes, schools, etc.

(c) A more rapid depreciation of the existing building stock in the designated area due to greater difficulty in arranging financing. To the extent that another flood makes these houses structurally unsound so that they must be replaced in locations outside the flood plain; this cost could be exceedingly high.

In order to appropriately evaluate the benefits and costs of providing a diversion one must forecast the development pattern of Carman without the diversion and compare it to that with the diversion. The cost of the diversion can be calculated from engineering studies. The benefit of the diversion includes not only protection of the existing level of development but any reduced costs of expansion in Carman attributable to the three points above.

To measure these impacts alternative scenarios have been constructed based on different development options and the net present value of the resulting benefit and cost streams have been computerized. The various assumptions are elaborated below. To a great extent this represents a further refinement of the benefit-cost analysis conducted previously. In this case the major change comes from the required adjustments brought about by designation of Carman as a flood hazard community.

J. PRELIMINARY BENEFIT-COST ANALYSIS OF THE CARMAN DIVERSION

The benefit-cost analysis conducted in this section of the report is primarily for illustrative purposes. Although the assumptions made in the analysis were chosen to be reasonable they are not definitive. It is also important to recognize that after designation there are only two paths open to the town; either construct some sort of structural flood control project, or relocate a major portion of the town. From a social welfare perspective the rational choice is the one that has the lowest cost. Consequently, the benefit-cost ratios discussed here are really indicators of the relative costs associated with each alternative. To put it simply, part of the benefits of the diversion are that you do not incur the cost of relocating the town.

Consequently, the designation of Carman as a flood hazard area requires recalculation of the benefits associated with a diversion. Designation results in precluding most forms of development in the 100-year flood plain. This results in additional expenses for any future development in the area. Rather than development occurring on a fill-in basis whereby vacant lots are occupied, buildings are converted to new uses or removed to make way for new buildings; any further development will require provision of all new public infrastructure outside the 100-year flood plain.

With designation it will become increasingly difficult to maintain viable commercial activity in the downtown core. Over time business will relocate to the north and south out of the flood plain. Difficulty in obtaining funds for new construction, the absence of federal and provincial grants and loans and a shift in residential location patterns will provide an incentive to relocate. The net effect will be higher costs to the town as a series of new infrastructure expenses are incurred, higher costs to the business community as new buildings will have to be constructed and higher costs to the consumer in terms of higher taxes, higher prices, and the inconvenience of a geographically dispersed set of business activities.

In an attempt to measure the benefit-cost ratio of a diversion subsequent to a designation some assumptions about structural changes will be made and analyzed. Sensitivity of the results to certain of these parameters will be tested. From this it will be possible to draw conclusions about the directions that Carman should proceed in the future.

Initially a set of assumptions about the underlying structure will be set out.

Over the past decade housing prices for new and old construction have increased at rates above general inflation levels. For the purpose of this exercise they will be projected as increasing at 3 percent per year above inflation. An average housing unit is assumed to have a 1981 cost of $50,000 if it is constructed in a newly developed area, $45,000 in an existing development, and $20,000 if it is upgrade of an older unit. For new construction the differential reflects different servicing costs.

Within the town there are currently 90 serviced lots that are available for construction that are not in the flood plain. There are also approximately 140 potential lots on land that is easily serviced but in the 100-year flood plain. These lots are shown on Figure 19. Once this land is used up any further development will require major expenditures on water and sewage systems.

Table 15 sets out the basic assumptions of the benefit-cost study in terms of six benefit or cost components. The objective of the calculation is to determine whether designation accompanied by a gradual abandonment of the flood plain imposes lower costs on society than the construction of a diversion. These assumptions represent conservative estimates of the costs associated with designation. For example, no costs of relocating public buildings are incorporated. Similarly, the relocation costs of commercial buildings as included would not allow more than one relocation per year.

The capital cost of the diversion is based on the costs developed by the Ad Hoc Task Force in the 1981 report. This report also was used to determine the annual maintenance costs.

Construction of the diversion provides immediate protection to the area subject to flood hazard. While designation may eventually eliminate flood damages the process could take 50 years if buildings are slowly be abandoned. Over that period the provincial and federal governments still provide damage compensation to all buildings that were in place prior to designation. To estimate this expected compensation the expected damage levels calculated from the flood frequency damage curves are adjusted in the following manner. First, 20 percent is deducted to reflect a lowering of market values that accompanies designation. This quantity is then depreciated by 5 percent a year over 50 years to reflect the gradual abandonment of the flood plain.

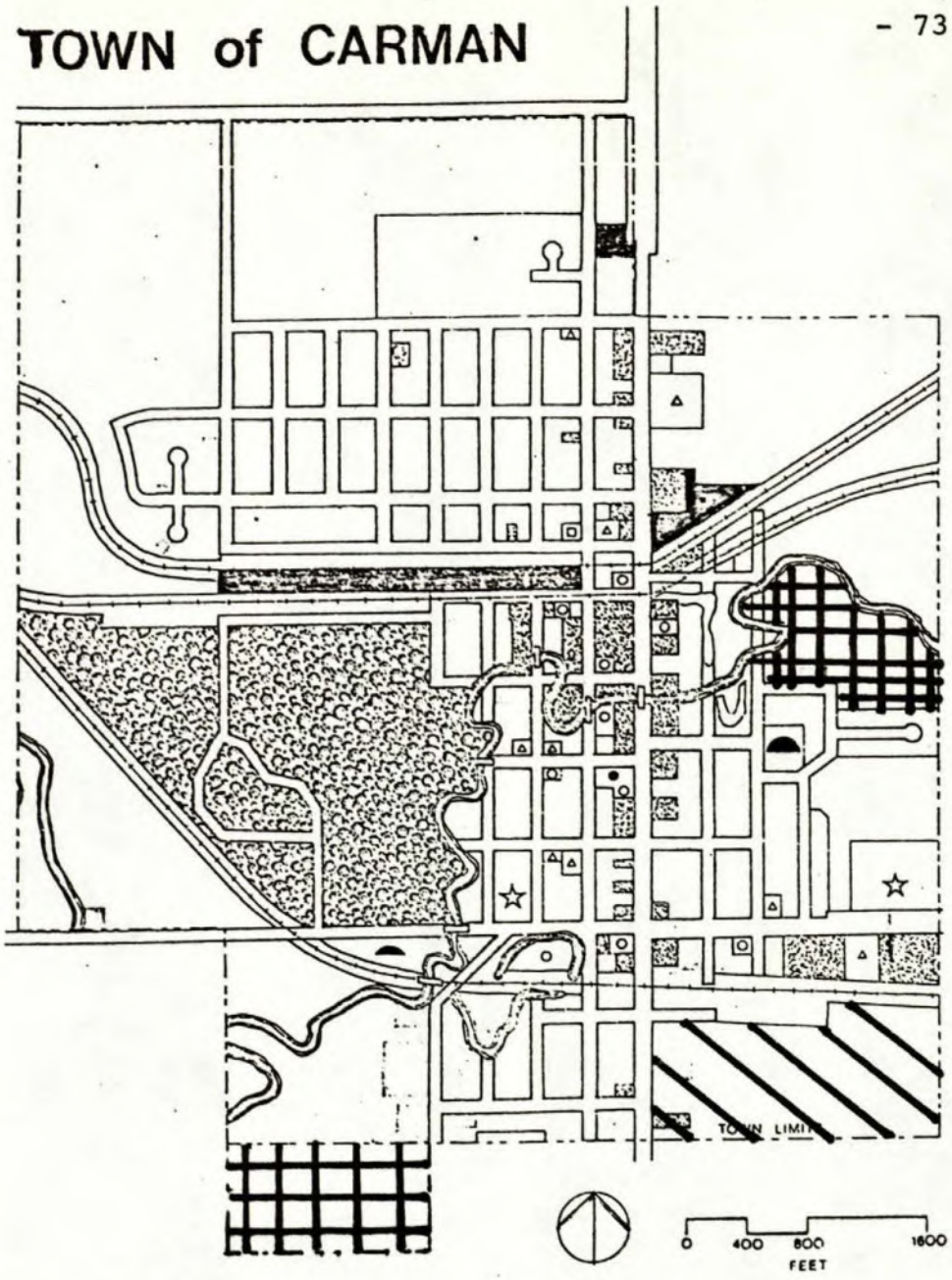

Figure 19 Potential Housing Development Sites and their Susceptibility to Flooding

Subject to Flooding

Free from Flooding

Table 15

Benefit and Cost Components
of the Diversion After Designation*

1.	Capital cost of the diversion	$6,316,000
2.	Annual maintenance costs of the diversion	63,160
3.	Annual flood protection benefits provided by the diversion	286,160 Declining at 5%/annum
4.	Cost to the town of servicing 60 acres of land - 60 x $5000/acre in Year 5	300,000
5.	Cost to society of constructing new homes to replace abandoned flood plain homes: (7 x $50,000) - (7 x $20,000) Equals $210,000 per year	210,000 per year for 50 years inflating at 3%
6.	Cost to society of moving non-residential buildings out of the flood plain earlier than would otherwise be required $300,000 per year for 15 years	300,000 per year for 15 years

* The dollar values associated with items 3, 4, 5, and 6 represent one possible scenario that involves fairly innocuous assumptions. Other assumptions can be readily introduced but the point of this analysis is not to compute a particular number but to provide a new methodology.

The fourth item reflects the cost to the town of providing infrastructure to a parcel of land earlier with designation than would be the case without. Once the existing 90 lots in the flood-free area are developed, new land will have to be serviced. In addition to any new housing to take care of expanding population this land will have to be used to replace abandoned flood plain sites. For illustrative purposes it is assumed that net additions to the town's population will require eight new homes a year over the next ten years. After this, the town's population will remain stable. With designation there will be an out-flow of families from the flood plain area into residential land

that is free from flooding. The net effect is that far more land for residential purposes is required and new developments are required sooner than would be the case with a diversion. Sixty acres are assumed to be developed in 5 years if a diversion is not built. This land should be sufficien to absort the outmigrants from the flood plain. With a diversion there are 140 lots within the flood hazard area of the town that can be used plus there will not be the abandonment of the flood plain. Consequently with the diversion the town can delay expansion beyond its existing boundaries.

New development to adapt to population growth will be required under either circumstance, so it need not be explicitly considered. A major difference in housing costs is introduced as the fifth item. With the diversion abandonment of flood plain housing can be avoided. Thus older homes can be renovated rather than new ones being built. If 7 homes per year will be abandoned on average this results in a net saving of $210,000 per year. Over the past decade housing costs have increased faster than the general rate of inflation so these costs are projected as having a 3 percent per annum real increase.

Similarly to take into account relocation of commercial and public buildings a fifteen-year adjustment period is postulated with net additional costs of $300,000 per year to incorporate the costs of moving to flood-free locations. Given curren construction costs for commercial buildings this will not allow rapid adjustment. To fully include all commercial relocation costs would require explicit assumptions of rates and patterns of adjustment as well as construction costs. Such assumptions were beyond the scope of this analysis.

Results of the analysis indicate that with the base set of assumptions the diversion is the least cost option for society. The calculated benefit-cost ratio is 1.05. Sensitivity of the results is tested by making the following changes:

(a) Discount rates of 5 and 15 percent are used, rather than 10 percent.

(b) Expected annual benefits of flood protection of $400,500 and $528,000 are used, rather than $357,700.

(c) Real costs of housing are increased at 0 and 1 percent, rather than 3 percent.

The results of these variations are presented in tabular form (Table 16), and are not discussed in detail. As is expected the benefit-cost ratio is rather sensitive to the discount rate and less so to the other adjustments. Using a 10 percent real discount rate as suggested by the Treasury Board and allowing for some incremental increase in construction costs beyond the general rate of inflation(10) suggests that given the existing policy to designate flood hazard areas, then construction of a diversion around Carman can be recommended as it imposes lower costs on society than designation and gradual abandonment.

Once again it must be reiterated that this analysis is meant to be representative of benefits and costs and is not definitive. It leaves out a number of costs such as relocation of public buildings and all "soft costs" such as mental anguish, pulled muscles, public health hazard and other inconveniences. The assumptions made about benefits are also subject to debate. It must, however, be noted that the benefits associated with diversion were made conservatively to minimize the possibility of their being overstated.

Table 16

Sensitivity Test Results for
Benefit-Cost Calcuations for Carman

Real Social Discount Rate	Percentage Rate of Real Price Increase In Residential Construction	Dollar Value of Initial Expected Annual Flood Damages		
		357,700	400,500	528,000
5	0	1.34	1.39	1.52
	1	1.43	1.48	1.61
	3	1.70	1.74	1.88
10	0	0.93	0.96	1.06
	1	0.96	0.99	1.09
	3	1.05	1.08	1.18
15	0	0.70	0.73	0.80
	1	0.72	0.74	0.82
	3	0.75	0.78	0.85

10. Treasury Board guidelines as indicated on page 18 of Benefit-Cost Analysis Guide state that where real costs are projected as increasing over time, this increase should be taken into consideration.

K. CONCLUSIONS

Conclusions of the study must be put in the context of the study. The study objectives were:

(a) identify the economic structure of the town of Carman in 1980 and note how it has changed from 1970;

(b) appraise the impact of flooding on the town over the 1970-80 period; and

(c) project the future development potential of the town under the flood free and flood hazard conditions.

The following set of conclusions are the result of the analysis developed in the report. In some cases they are directly reproduced from a preceeding portion of the report. In other instances they are the result of a synthesis of ideas that occur in various places in the report. In all cases they are the responsibility of the authors.

(a) Carman by virtue of a number of geographical and historical influences is well-situated to take advantage of what appears to be a major increase in corn production in Manitoba, particularly production in the Red River Valley. It will, however, require aggressive pursuit of the opportunities by residents of Carman if they wish to remain a major centre for corn production and handling. Another important factor that will influence the desirability of Carman as a centre for corn is resolution of the flood hazard problem.

(b) During the 1970-80 period there was a major expansion of the financial sector evidenced by the opening of new offices by four of the five banks and a new credit union building. The retirement industry expanded greatly in this period with major expansion of the number of housing units and other facilities for senior citizens. Thus, the first two floods did not cause great stagnation in Carman.

(c) The town has a strong export sector consisting of implement dealers, limited light manufacturing, corn handling and greenhouse-nursery products. These firms in some cases are the leaders in their field in Manitoba. Thus the town generates a strong flow of income from sales to non-residents.

(d) Building activity in the 1970-80 period was more influenced by general economic conditions than flooding. Construction occurred both within and outside the flood plain although residential construction, in particular, was concentrated outside the flood plain.

(e) The flood of 1979 - the third flood in a decade - brought about a major shift in attitude. Residents began to believe flood hazard would be a recurrent problem rather than an infrequent one. Current plans are conditioned by expectations of future flooding.

(f) Although there has not been a definitive answer to the cause of the floods - in particular the contribution of upstream drainage - this issue is largely irrelevant. Carman's problem is how to deal with flood hazard not ascertain the cause.

(g) Previous benefit-cost studies may have understated the benefits from a diversion but not considering sensitivity of damage-reduction curves but their ultimate conclusion - that a diversion could not be justified given the institutional rules in effect at the time was correct.

(h) With designation of part of Carman as a flood hazard area the institutional rules are alterred significantly. Subsequent to designation the town cannot continue on its present path. Only two options are open:

  (i) construction of a structural control device to protect the town; or

  (ii) gradual abandonment of the flood plain.

(i) A benefit-cost study of these two alternatives indicates that using realistic projections the diversion results in the lowest costs to society.

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APPENDIX A

CARMAN INDUSTRIAL STRUCTURE BREAKDOWN

1970

AGRICULTURE INDUSTRIES

Division 1

A & M Soil Service Centre

Agricultural Extension Service

Aubin Nurseries Ltd.

Carman Greenhouses and Market Gardens

Circle Three Custom Feeders

Dufferin Agricultural Society

Dufferin Feed Service

Garwood, M - Mink Ranch

Healthy Hog Enterprises Ltd.

McEachern, D. - Potatoes

Stow Associates - Farms

Stow Seed Farms

Swanton Seed Service

Vandersluis, Bill - Greenhouses

Vanderveen Greenhouses and Market Garden

MANUFACTURING INDUSTRIES

Division 2

Major Group 1 - Food and Beverage Industries

Carman Frosted Foods - Slaughtering, Sausage Making

Major Group 6 - Furniture and Fixtures Industries

Miller's Upholstering

Major Group 10 - Machinery Industries

Lockwood Grader Corporation

Major Group 13 - Non-Metallic Mineral Products

Carman Granite and Marble Works

CONSTRUCTION INDUSTRIES

Division 3

Carman Plumbing and Heating Company

Dick's Heating

Ducharme, Roy A. - Excavation

Geisbrecht, Pete - Contractor

Main Construction Ltd.

Ross J.B. Construction and Supplies Ltd.

Spencer and Thiessen Ltd.

Carman Co-op Lumber Yard and Construction

TRANSPORTATION, COMMUNICATION AND OTHER UTILITIES

Division 4

CBC

CNR Station

CPR Station

Carman Transfer

Carman Vegetable Storage Ltd.

DER Enterprises Aircraft Service

Dufferin Leader

Epps Transfer

Post Office

Harms The Mover

Hudson R.H. Transfer

Joe's Taxi

Lionels Transfer

Manitoba Hydro

Manitoba Pool Elevators

Swark, Roy - Trucking

United Grain Growers - Elevators

TRADE INDUSTRIES

Division 5

Major Group 1 - Wholesale Trade

Bearing and Automotive Wholesale Company

Canada Co-op Implements

Carduff Farm-Serve Ltd.

Carman Auto Wrecking

Carman Co-op Bulk Petroleum and Fertilizers

Carman Farm Equipment Ltd.

Gulf Oil Canada Ltd.

Imperial Oil

Johnston Farm Supplies Ltd.

Shell Canada

Texaco

W. W. Implements

Western Propane Ltd.

Major Group 2 - Retail Trade

Beaver Lumber

Bill's Texaco Service

Bowie's Bakery

Brad's Jewellers

Bruce's Furniture Store

Campbell Grocery

Campbell's Town and Country Service

Campbell's Ready-Mix Concrete

Carman Auto Body Shop

Carman Co-op - Grocery

Carman Co-op Service Station

Carman Flower Shop

Carman Fruit and Vegetables

Carman Hardware

Carman Motor Products

Carman Radio and T.V. Service

Carman Tire Shop

Central Shell

Ed's Tire Shop

Hardy's Garage

Harris' Clothes Shop Ltd.

Laycock Motors

Liquor Control Commission

MacLeods

Malcolmson H.C. Druggist

Mary's Auto Body Clinic

Pat's Service

Porter's Garage Ltd.

Robinson Stores

Safeway

Sanders Drug Store

Shilson's Grocery

Simpsons Sears

Skelton's Hardware

South End Shopping Centre

Spruce Photo Studio

Parkway Motors

Carman Fabric Centre

FINANCE, INSURANCE, AND REAL ESTATE

Division 6

Bank of Montreal

Canada Imperial Bank of Commerce

Co-op Insurance

Dufferin Credit Union

Green-Fields Realty

Hand AJ Agencies

Newman Agencies

COMMUNITY, BUSINESS AND PERSONAL SERVICE INDUSTRIES

Division 7

Major Group 1 - Education and Related Services

Carman Consolidated School

Midland Collegiate

Midland School Divison #25

Roseisle School

Major Group 2 - Health and Welfare Services

Bendinger, Dr. D.W. - Dentist

Calverly, Dr. J.

Carman Medical Group

Carman Memorial Hospital

Cochrane H.R. - Optometrist

Dr. E.K. Cunningham

Dr. D. Hill

Dr. H. North

Dr. J. Regehr

Southern Health Unit

Samson, Dr. T. J.

Major Group 3 - Religious Organizations

Anglican Church Rectory

Canada Performed Church

Carman United Church

Catholic Parish of Our Lady of Mount Carmel

Church of Christ Manse

Gospel Light Mennonite Brethern Church

St. John's Anglican Church

Major Group 4 - Amusement and Recreation Services

Beaver Hockey Club

Boyne Theatre

Carman Bowling Lanes

Carman Co-op Flying Club

Carman Curling Club

Carman and Dufferin Recreation Commission

Arena

Memorial Hall

Carman Golf Club

Carman Kinsmen Club and Fairgrounds

Major Group 5 - Services to Business Management

Bedford, C. N. - Barrister

Chambers Fraser and Collins - Chartered Accountants

McKenzie, R. - Barrister

Major Group 6 - Personal Services

Bowie's Beauty Parlor

Carman Beauty Parlor

Carman Cleaners

Doyle's Funeral Chapel

Flo's Beauty Salon

Muriel's Style Shop

Major Group 7 - Accommodation and Food Supplies

Carman Co-op Lunch Bar

Carman Motor Hotel

Fireside Inn

Helen's Coffee Shop

J. K. Motel

Rex Cafe

Ryall Hotel

Syl's Drive Inn

Yueng Jack Restaurant

B.A. Service Station and Lunch Room

Major Group 8 - Miscellaneous Services

Collomb Service - Repairs

North End Welding and Repairs

Royal Canadian Legion

PUBLIC ADMINISTRATION AND DEFENCE

Division 8

Carman, Town of
- Fire Hall
- Fire and Water Department

Land Titles Office

Policy

RCMP

Manitoba Government
- Highways Branch
- Motor Vehicle Branch
- Department of Health

Veterans Land Administration

Federal
- Post Office
- Farm Credit Corporation

INDUSTRY UNSPECIFIED

Division 9

James R. W. Electric

Protective Chinchilla Services Ltd. - Commercial Priming and Pelting

APPENDIX B

CARMAN INDUSTRIAL STRUCTURE BREAKDOWN

1980

DIVISION 1 AGRICULTURE

A & M Soil Service

Aerial Spray & Charter Ltd.

Aubin Nurseries Ltd.

Braun, Ernest - seed cleaning

Carduff Farmserve Ltd.

Carman Agri Services Ltd.

Carman Vegetable Storage Ltd.

Dufferin Ag. Society

Dufferin Feed Service Ltd.

Epp Strawberry Farm

Flatland Feeders

J. J. Farms

MAC Hog Farms

Man. Corn Growers Marketing Assoc.

Midland Seed Farm

Northern Sales Co-Swanton Seed Division

Seedex Ltd.

Stow R.T. Ltd. - dry bean warehouse

Vanderveen Greenhouses Ltd.

Wayne's Mobile Feed

Linear Agra Ltd.

McEachern E.D.

DIVISION 2 MANUFACTURING

Major Group 1 - Food & Beverage Industries

Carman Frosted Foods

Plains Processors (horse plant)

Major Group 5 - Wood Industries

Suncraft Wood Products

H & B Truss

Major Group 15 - Chemicals & Chemical Products Industries

Foremost Sailcraft Ltd.

Major Group 16 - Miscellaneous Manufacturing Industries

Kimberley-Clark of Can. Ltd. - Flax Straw Div.

DIVISION 3 CONSTRUCTION INDUSTRIES

Boyne Septic Services

Carman Plumbing & Heating Co.

Carman Co-op Const. & Lumber Yard

Dick's Heating

Jack's Air-Cooled Service

Johnston Electric Ltd.

Norcan Development Ltd.

Spencer & Thiessen Ltd.

Swark, Roy - excavator

Wieler Electric

Valley Enterprises

Enns Drywall

DIVISION 4 TRANSPORTATION, COMMUNICATION & OTHER UTILITIES

Bus Depot

C.B.C.

Carman Transfer

DER Enterprises - aircraft service

Epps Transfer

Harms H. F. The Mover & Sons Ltd.

Man. Hydro

Southwest Transfer

U.M.A. Packing Ltd.

Valley Leader

DIVISION 5 TRADE INDUSTRIES

Major Group 1 - Wholesale Trade

Co-op Ltd. - farm supplies & bulk petroleum

Carman Farm Equip. Ltd.

Carman Bearing & Automotive Wholesale Co.

Co-op Implements

Gillis & Warren Ltd. - ind. & hardware wholesale

Johnston Farm Supplies

Midland Farm Services

W. W. Implements Ltd. - farm eq.

Western Propane Ltd.

Man. Pool Elevators

Gulf Canada Products Co.

Imperial Oil Sales Agency

Shell Canada

Texaco

Major Group 2 - Retail Trade

Adamson's Health Foods

August Service

B & D General Store

Beaver Lumber Co. Ltd.

Bill's Texaco Service

Boyne Auto Clinic

Brad's Jewellers

Campbell Grocery

Carman Auto Body Shop

Carman Combine & Equip. Ltd.

Carman Co-op Ltd. - Grocery & Hardware

Coachline Auto Body

Carman Flower Shop

Carman Furniture

Carman I.G.A.

Carman Radio & T.V. Ltd.

Chimo Bldg. Centre

Carman Bakery

Carman Creamery Co.

Collomb Service

Don's Esso

Dyck's Garage

Ed's Tire Service Ltd.

Franz Fabrics

Harris Clothes Shop

Irene's Ladies Wear

Jan's Gulf Service

K & K Sales & Service

Liquor Control Commission

Livingston's Carman

MacLeods

Midland Muffler & Cycle Service

Parkland Floor Coverings

Parkway Motors

Pennco Sales Ltd.

Pethybridge J. E. Ltd.

Pop Shoppe Bus Stop (Jan's Gulf)

Porters Garage Ltd.

Prairie Agri Photo Ltd.

Radio Shack

Robinson Stores

Ross Hanks & Son Gulf Oil

Sander's Drug Store

Sears

Southdale Sales Ltd.

Thumbprints Handcraft & Gift Boutique

White Elna Sewing Centre

Women's World Ladies & Children's Wear

Cleanair of Manitoba

Coachline Auto Body & Mfgs. Co.

Knock Abouts and Fancy That

DIVISION 7 — COMMUNITY, BUSINESS AND PERSONAL SERVICE INDUSTRIES

Major Group 1 - Education & Related Services

Boyne Regional Library

Carman Collegiate

Dufferin Christian School

History Research Co-ordinator

Midland School Division #25

Carman Elementary

Carman Elementary Resource Center

Mennonite School - West

Carman Christian Academy

DIVISION 6 FINANCE, INSURANCE, AND REAL ESTATE

Bank of Montreal

Brookdale Agencies - real estate

Can. Imperial Bank of Commerce

Co-operators,The

Dufferin Credit Union

Royal Bank

Hand Agencies Ltd. - insurance

Man. Agricultural Credit Corp.

Newman Hall Agencies Ltd.

Societe Du Credit Agricole

Toronto Dominion Bank

Triangle Realty

Voth, Herman R. - insurance

F.C.C.

Major Group 2 - Health & Welfare Services

Dr. G. W. Bendinger - dentist

Boyne Lodge - Senior Citizens Home

Dr. J. Caverley

Friendship Centre

Boyne Towers

Carman Medical Group

Carman Memorial Hospital

Carman Opthalmic Services - Dr. Baloo above

Community Self Help Centre

Dr. G. O. Hanson - surgeon

Dr. J. W. Hewett - chiropractor

Dr. J. Rigehr

Dr. R. McGregor - family practice

Dr. C. Chung - family practice

Dr. T. J. Lawson - veterinarian

Major Group 3 - Religious Organizations

Can. Reformed Church Manse

Carman Gospel Light Church

Carman Mennonite Church

Catholic Parish of Our Lady of Mount

Church of Christ

Grace Lutheran Church

Homewood Mennonite Church

Our Lady of Mount Carmel Catholic Parish

Carman United Church

St. Johns Anglican

Major Group 4 - Amusement & Recreation Services

Boyne Theatre

Carman Bowling Lanes

Carman Co-op Flying Club

Carman Curling Club Fairgrounds

Carman & Dist. Community Hall Inc.

Carman & Dufferin Recreation Commission

Arena

Memorial Hall

Carman Golf Club

Major Group 5 - Services to Business Management

Brown, Mona - barrister

Freepress Agent

Lee, Brock - barrister

Lepage, A. E. - Oldfield, Kirby & Gardner - real estate

McKenzie Mooney & Brown - barristers

Mooney, T. R. - barrister

Nakonechny & Power Chartered Accountants

White, Horace G. - income tax service, bus. accounting

Wilson Selinger & Co. - law office

McKenzie, Roht - lawyer

G. T. Selinger - lawyer

Birch Findlay, accounting service

Major Group 6 - Personal Services

Carman Beauty Parlor

Carman Granite & Marble Works

Carman Launderama

Carole's Beauty Shoppe

Doyle's Funeral Chapel

Flo's Beauty Salon

Norma's Hairdressing

Norm's Hairstyling

Major Group 7 - Accommodation & Food Supplies

Carman Motor Hotel

Carman Motor Hotel Restaurant

Chicken Chef

Chicken Delight

Fireside Inn

Golden Star Motel

Coffee Pot

Ryall Hotel

Major Group 8 - Miscellaneous Services

Carman Shoe Repair

Carman Masonic Lodge

Campbell's Town & Country Repair Shop

Carman Welding & Repair

Dufferin Welding Repair

Valley Fabricators (welding)

Kinsmen

Lion's Club

Knights of Columbus

DIVISION 8 PUBLIC ADMINISTRATION AND DEFENCE

RCMP

Chamber of Commerce

Town of Carman

Dufferin, Rural Municipality of

Canada:

- Post Office
- Department of Agriculture
- Farm Credit Corporation

Manitoba:

- Agriculture
- Health and Community Services
- Highways and Transportation
- Natural Resources

DIVISION 9 INDUSTRY UNSPECIFIED

Aubin & Russell Ltd.	745-2046
Kamrock Enterprises Ltd.	745-3311

APPENDIX C

CARMAN COMMERCIAL SECTOR QUESTIONNAIRE

Carman Business Survey

PART ONE

General Characteristics

What is the major type of business? _____

What % of sales come from

1) Residents of Carman? _____
2) " of R.M. of Dufferin? _____
3) Other areas? _____

Where is your major supplier located? _____

How many employees do you have:

	Full Time	Part Time
1-5	_____	_____
6-10	_____	_____
11-15	_____	_____
16-20	_____	_____
21-30	_____	_____
31-50	_____	_____
> 51	_____	_____

What proportion of your labour force lives in

1) Carman? _____
2) R.M. of Dufferin? _____
3) Elsewhere? _____

...2/

What is your average wage for full-time employees?

/hr.	40 hr. wk.	52 wks/yr.	
less than $3.50/hr.	less than $140/wk.	less than $7,280	____
3.51 - 5.00	140 - 200	7,280 - 10,400	____
5.01 - 7.00	200 - 280	10,400 - 14,560	____
7.01 - 10.00	280 - 400	14,560 - 20,800	____
> 10.00	more than 400	more than 20,800	____

What range describes your gross value of sales (in thousands of dollars)?

50-75 ____
75-100 ____
100-125 ____
125-150 ____
150-200 ____
200-250 ____
250-300 ____
> 300 ____

PART TWO

Flood Impacts

During the last flood, how many days were you closed? _____

Did you undertake any flood protection measures just before the flood? _____
If so, were they successful? _____
Have you undertaken any protection measures since the flood? _____
Do you believe that, as a result of the flood, you lost any business permanently to competitors outside Carman? _____

...3/

Does the danger of flood act as a deterrent to investment in your business directly or indirectly? _____

directly - opportunity for expansion is there, but unwilling to take the chance of flood damage

indirectly - flood hazard reduces the opportunity to expand business

# # #

AE/July/81
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