Public Participation in the Emergency Response Phase of Flooding: A Case Study of the Red River Basin

by
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A thesis submitted to the Faculty of Graduate Studies in partial fulfillment of the requirements for the degree of

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ABSTRACT

Emergency flood response is a controversial phase in flood management mostly because there is virtually no public input into important decisions such as evacuation orders. Little attention has been paid to the potential for involving the public more in decision-making in this phase of flood management. The purpose of the study was to investigate whether more public involvement in the emergency response phase would create greater support for government action, minimize uncertainty and dissatisfaction, and improve overall flood management. The specific objectives were to: 1) identify and describe key publics, government agencies, and civic organizations involved in emergency flood response; 2) determine the understanding that the public had of their role in emergency flood response; 3) identify and describe interactions among key participants during the emergency flood response phase; 4) evaluate public involvement practices in the emergency response phase; and 5) develop recommendations to improve public involvement in the emergency response phase of a flood.

A case study approach involving two communities from Canada and the United States in the Red River Basin was used to accomplish the objectives of the study. One community was the village of Rosenort in Manitoba, and the other was the city of Drayton in North Dakota. Data collection methods included document review and semi-structured qualitative interviews.

The results establish that community members in both towns made important decisions regarding how to protect their individual property as well as the community as a whole. They carried out individual activities such as sandbagging, moving furniture to higher ground, and watching pumps to ensure that they continued to run. Communal

activities in Rosenort included the building of neighbourhood dikes in some parts of town, and in Drayton, the building of a plywood wall around the city. Local governments in both jurisdictions made key decisions about the provision and distribution of resources for use in the emergency. They also planned for the evacuation of their communities. There was no input from the general public into these decisions. However, local government officials maintained close links with many community members. Provincial/state government officials and federal agencies played a critical role in providing resources to prepare and respond to the flood. Provincial/state government officials were also responsible for calling the mandatory evacuation of the two communities. This was a key decision that impacted the ability of locals to carry out their response activities, yet was made without public input or input from local government officials. There was also little involvement in the emergency preparedness planning prior to the flood.

The data show that the communities' roles in the emergency response phase are important, and that ways and means need to be found to involve them more in key decisions made during this phase. There are clear opportunities for this to occur during the development of emergency response plans before a flood. There are even opportunities for limited public involvement during the emergency as demonstrated by the Drayton data. Recommendations are made for capitalizing on these opportunities.

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CHAPTER 1: INTRODUCTION

1.1 Geography and flood history of the Red River

The Red River flows northward from its headwaters in Minnesota to its outlet at Lake Winnipeg in Manitoba, meandering through the flat and fertile valley of the former glacial Lake Agassiz. Its river basin occupies substantial portions of North Dakota, northwestern Minnesota, southern Manitoba, and a very small portion of South Dakota. It covers 116,500 square kilometres (km^2), excluding the Assiniboine River Basin, which joins the Red River at Winnipeg (Figure 1).

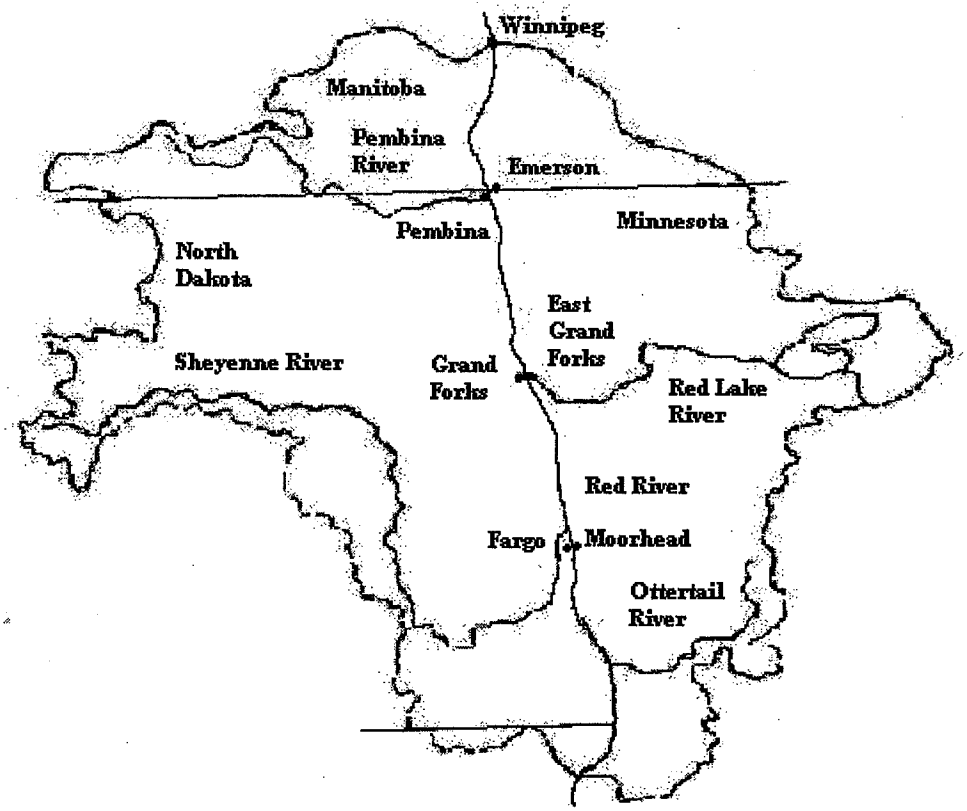

Figure 1: The Red River Basin (Source Krenz and Leitch, 1993)

The Red River Basin is very flat. From Wahpeton, North Dakota to Lake Winnipeg, the river falls by only 70 meters (m) in a distance of 872 kilometres, an average slope of only 0.1 m per km (IJC, 2000). Therefore, during major floods, a very large portion of the valley is inundated.

The Basin has a sub-humid/humid continental climate with moderately warm summers, cold winters, and rapid changes in daily weather patterns (IJC, 2000). Extreme temperature variations are common, with the mean monthly temperatures ranging from -15 degrees to +20 degrees Celsius. Annual precipitation is approximately 50 centimetres (cm) and mostly occurs from April to September, with almost two-thirds falling in May, June and July. The months between November and February are the driest, with precipitation averaging only about 1.3 cm per month.

The climate and the topography of the Red River Basin ensure that it experiences floods regularly. Most flooding occurs after there has been heavy precipitation the previous fall, hard and deep frost prior to snowfall, substantial snowfall, sudden thaws, or heavy rainfall during spring break-up (IJC, 2000). The low absorptive capacity of the basin's clay soil and the presence of ice jams in some parts of the river further exacerbate the flooding situation (IJC, 2000).

There have been several major floods in the Red River Basin in the 19th and 20th centuries. The most notable ones of the 19th century are those of 1826, 1852, and 1861. The most notable ones of the 20th century are those of 1950, 1966, 1969, 1974, 1979, 1996, and 1997. The flood of 1826 was the largest known flood. According to St. George and Rannie (2003), historical accounts and paleoclimatic data show that prior to the flood, the month of April was cold and snowy, and spring unusually late throughout most

of central North America. The 1826 flood was further intensified by heavy rainfall during the rising stage (St. George and Rannie, 2003). The estimated peak flow for 1826 is about 6,370 cubic metres per second (m^3/s), 40% greater than the 1997 flood (St. George and Rannie, 2003). This estimate exceeds the current design capacity of flood protection for Winnipeg, leading to the conclusion that future floods of similar magnitude would break flood defences, and cause great damage (St. George and Rannie, 2003).

The flood of 1950 was significant because for the first time both provincial and federal governments began to formally contribute financially to flood relief restoration (Emergency Preparedness Canada (EPC), 1999). In addition, following the flood, large-scale structural flood damage measures such as the Red River Floodway, the Portage Diversion, and the Shellmouth Dam were constructed to protect Winnipeg. The Floodway is an excavated channel about 46 km long that diverts water in excess of 1620 m^3/s around the city of Winnipeg from south to north. The Portage Diversion, 3.2 km west of the city of Portage, consists of a diked earth channel, a diversion dam, and a spillway dam. It diverts water from the Assiniboine River to Lake Manitoba. The Shellmouth Dam is located at the upper end of the Assiniboine River and consists of an earthfill dam, an overflow spillway, and a reservoir. It provides water storage and controls reservoir outflows to minimize downstream flooding in spring or during summer rainfall flood conditions (EPC, 1999).

The 1969 flood, although minor, was significant in that it was the first flood after the construction of the Red River Floodway. Although there was no flooding in Winnipeg, residents immediately south of the Floodway claimed that it had worsened flooding in their communities (EPC, 1999). This was the beginning of conflict over

perceived inequities in protection that persists until today between Winnipeg residents and non-residents.

The flood of 1974 was similar to the one in 1969. There was heavy tributary flooding as a result of heavy precipitation and rapid snowmelt. In addition to high water levels on the Red River, there was flash flooding on the Morris, Roseau, Rat, Seine, Assiniboine, Pembina, and Boyne Rivers (Bumsted, 1997). More than 2,500 residents in Manitoba were evacuated by the end of the flood. The Red River flood of 1974 is significant because it was one of many flood events that occurred in Canada at the time. For example, in 1973-1974, the Great Lakes experienced high water levels because of a combination of high precipitation and low evaporation. Major storms combined with these high water levels caused severe damage to property on the shores of the Great Lakes (Bruce, 1976). In Saskatchewan, the winter of 1973-1974 was characterized by near-record snowfall, and by the end of winter, several areas reported extremely heavy snow cover (Environment Canada, 2003). Spring runoff from this extremely heavy snow pack resulted in widespread flooding in the Qu'Appelle River basin. The most serious flooding developed in Moose Jaw, Regina and Lumsden, where major damage occurred (Environment Canada, 2003).

These flood events prompted the federal government to initiate the national Flood Damage Reduction Program (FDRP) in 1975. Under this program, federal and provincial/territorial governments (including Manitoba) signed agreements to reduce the possibility of flood damage by discouraging development in flood zones through the withdrawal of mortgage guarantees and other financial measures (Bumsted, 1997). Further details about the FDRP are discussed in Chapter Two.

1.2 Red River flood of 1997

The 1997 flood was the highest recorded in the 20th century. It was caused by heavy snowfall, high topsoil moisture, and a blizzard in April (EPC, 1999). The flooding began in the United States (IJC, 1997). In the towns of Wahpeton, North Dakota and Breckenridge, Minnesota, the Red River crested on April 6th and April 15th 1997 respectively at approximately 6 m, which was almost twice the normal flood level. As the Red River flowed north, other American towns and cities such as Moorhead, Ada, Grand Forks, East Grand Forks, and Drayton were successively inundated by floodwaters.

In 1997, the peak discharge at Emerson (Canada-U.S. border) was approximately 3,681 m^3/s, compared with 2,662 m^3/s in 1950. At the floodway inlet just south of Winnipeg, the peak discharge was approximately 4,474 m^3/s, as compared to 2,662 m^3/s in the 1950 flood (EPC, 1999).

In Manitoba, an estimated 1,840 km^2 of land were flooded when the Red River rose 12 m above winter levels (Warkentin, 1997). The city of Winnipeg and other ring diked communities managed to stay relatively dry, but other communities in the floodplain, such as Ste. Agathe and Grande Point were flooded. Throughout the Red River Basin, homes, businesses, and farmsteads were damaged and destroyed. More than 100,000 people were evacuated, with 28,000 of them from Manitoba.

At the onset of the flood in the United States, about 8,000 head of cattle, hogs, poultry, and sheep died in the floodwaters (IJC, 1997). In Manitoba, approximately 5% of farmland was under water at the flood's peak. Some farmers had to move approximately 2,000 cattle and 45,000 hens to higher ground (Morris-Oswald, 2000).

A variety of hazardous products found their way into the floodwaters. For example,

a fertilizer building near Grand Forks was flooded, and about 4,000 tons of urea and 1,000 tons of phosphate entered the floodwaters. In Manitoba, municipal sewage lagoons in the towns of Emerson, St. Jean, Morris, and Otterburne were flooded.

In the end, the cost of the flood in Canada was estimated to be approximately $400 million, while the total cost in both Canada and the United States was estimated to be about $2 billion (de Loe, 2000).

1.3 Emergency flood response

There are three phases of flood management: **planning and mitigation**, **emergency flood response,** and **post flood recovery**. The planning stage involves the evaluation of alternative mitigation measures for possible implementation in order to reduce flood damages in a region. Evaluation of these alternatives involves project formulation, understanding the advantages and disadvantages of each alternative, the assessment of project impacts, and the comparison of alternative measures (Simonovic, 1999).

'Preparedness' involves planning and preparation. Planning involves setting the procedures that are going to be used to save lives and minimize damage when an emergency occurs. It includes the establishment of flood forecasting, monitoring and warning systems, evacuation procedures, and public information services. Preparation involves activities carried out in readiness for the flood event and may include activities such as sandbagging, diking, and moving items to higher ground.

'Response' occurs after the onset of a flood event. It is defined as the actions taken to save lives and prevent further damage in an emergency situation. Response may include activities such as evacuation, search and rescue, and the provision of basic

necessities to flood victims. Some preparation and response activities may overlap. For example, sandbagging and diking activities may take place during preparation as well as response.

In Canada, when flooding occurs, the initial responsibility for emergency response lies with the individual (e.g. homeowners and businesses), and the local authority. If local authorities cannot manage an emergency, the provincial or territorial government is called in to assist. Similarly, the federal government may make its resources available upon request, when a province or territory cannot effectively respond to an emergency or if the emergency lies within federal jurisdiction.

As in Canada, emergency preparedness and response in the United States is primarily the responsibility of individuals and local governments. In instances where the disaster exceeds the capabilities of local governments, the state government is usually called in to help. Similarly, if the disaster exceeds the capabilities of the state government, the federal government is called to lend its assistance.

Emergency flood response is a controversial phase in flood management due to decisions made on issues such as evacuation and mitigation. For example, during the Red River flood of 1997, community residents in Manitoba were opposed to mandatory evacuation due to the lack of consultation before the decision was made, the tactics used in the evacuation process, and the subsequent flood damage to their property in their absence (Haque, 2000). Most community members who were evacuated would have preferred to stay and fight the flood (Rasid et al., 2000).

With regard to mitigation, many residents near Winnipeg did not know ahead of time when the Floodway gates would be raised. Many also felt that Floodway operation

impacted water levels upstream. This resulted in inaccuracies in the forecast of water levels, and thus affected their ability to prepare for the flood (Manitoba Water Commission, 1998). This fueled the existing notion of inequity between Winnipeg and non-Winnipeg residents when dealing with flood management issues. Some non-Winnipeg residents who lived in the floodplain felt (and continue to feel) that the floodway benefited the city of Winnipeg and its residents at their expense (Shrubsole, 2001). In the end, the lack of public involvement surrounding government action during the emergency response phase of the 1997 flood created uncertainty and dissatisfaction among floodplain residents (Shrubsole, 2001).

The post flood recovery phase involves actions taken to return the community to normal following a disaster (Alexander, 1993). It includes the evaluation of damages, repairing, replacing, or rebuilding property, and the provision of flood assistance or compensation to victims.

1.4 Research purpose and objectives

The purpose of this study was to investigate whether more public involvement during the emergency response phase of flood management would minimize uncertainty and dissatisfaction, and improve flood management. The specific objectives of the research were to:

- Identify and describe key government agencies, and civic organizations involved in emergency flood response.
- Determine the understanding that the public had of its role in emergency flood response.

- Identify and describe interactions among key participants during emergency flood response.
- Evaluate public involvement practices in the emergency response phase.
- Develop recommendations to improve public involvement in the emergency response phase.

1.5 Study Sites

Two communities were selected from different jurisdictions (Canada and the United States) in the Red River Valley. One community was the village of Rosenort (Rural Municipality of Morris) in Manitoba, and the other community was the city of Drayton (Pembina County) in North Dakota. Although neither town flooded, they were significantly affected by the flood of 1997, and were evacuated at some point during the emergency. Chapter Three provides a detailed description of the two communities and how they were selected.

1.6 Methods

The research design was a qualitative comparative case study approach comprised of two components. First, secondary data were collected by reviewing relevant literature from sources such as libraries, non-governmental organization (NGO) records, news media accounts, and government agency files and records. Second, semi-structured interviews were conducted with key informants from NGOs, government officials (from federal, provincial/state, municipal/county, and city levels), local community groups, and individuals on both sides of the border. Finally, the data were analyzed using QSR N4 computer software, and the results of the analyses were verified by comparing them to

the raw data and the literature. Again, Chapter Three provides a detailed description of the research methods.

1.7 Organization of Thesis

The thesis is organized into six chapters. Chapter One covers the general introduction, states the purpose and objectives of the research, and outlines the general methods used to acquire and analyze the necessary data. Chapter Two provides a description of flooding and flood management in Canada, and emergency response governance in Canada and the United States. Chapter Two also includes a review of the literature on public participation and emergency flood response. Chapter Three provides an in-depth description of methods used to conduct the research, and also includes a description of the study area. Chapter Four presents the results, and Chapter Five discusses these results. Chapter Six presents conclusions and recommendations based on the study results.

CHAPTER 2: FLOODING AND EMERGENCY RESPONSE

2.1 Introduction

Flooding is an important natural process that plays a vital role in the maintenance of floodplains and shoreline ecosystems (de Loe, 2000). It occurs when the volume of water in a river exceeds the capacity of the river channel, or when higher than normal water levels inundate low-lying areas along lakes or coastal shorelines (Environment Canada, 1993).

Humans have historically occupied floodplains because of the benefits associated with such occupancy. These include access to fertile farmland and access to water for transportation, drinking, and sewage disposal (Alexander, 1993). However, human occupancy of floodplains has interfered with natural systems and ecological processes (Environment Canada, 1993). It has led to the draining and filling of wetlands (which act as natural sponges that hold water back and release it gradually), and turned flooding into a hazardous phenomenon (because flooding puts lives and property at risk) (de Loe, 2000).

2.2 Causes of flooding in Canada

Flooding in Canada can occur at any time of the year and for various reasons (Environment Canada, 1993). For example, in British Columbia, melting snow and heavy rainfall are the major causes of flooding. One of the most serious floods in the province occurred in 1948, when heavy rainfall caused the Fraser River to overflow its banks. The flood caused millions of dollars in property damage, and severely disrupted the economy of the province (Day, 1999).

In Ontario, flooding is caused by snowmelt, spring rainfall storms, summer

thunderstorms, tropical storms or hurricanes, and ice jams. The most severe flooding on record occurred in October 1954 when Hurricane Hazel passed through the Toronto area causing the deaths of 81 people and leaving 4,000 people homeless (Environment Canada, 1993).

In the Great Lakes region of Ontario, flooding is caused by fluctuations in water levels due to seasonal changes in weather conditions. These fluctuations can lead to shoreline flooding especially when they occur in association with storm events. For example, a storm on December 2, 1985 raised water levels on Lake Erie and caused considerable flooding in the surrounding areas (Lawrence and Nelson, 1999).

In Quebec, heavy rainfall is one of the major causes of flooding. For example, torrential rains caused the Saguenay Flood disaster of 1996, in which approximately 1,718 homes were destroyed or damaged and 16,000 people were evacuated (Fung et al., 1998). In Manitoba, flooding is mainly associated with the Red River Basin. As mentioned earlier, some of the causes of flooding in the Basin are heavy precipitation in autumn, hard and deep frost prior to snowfall, sudden thaws, or heavy rainfall during spring break-up.

Estimates of total annual financial losses due to flooding in Canada are not available because of reporting and accounting problems. However, damages associated with particular events provide some insight. For example, costs associated with the 1996 Saguenay flood in Quebec are estimated to be $800 million (Grescoe, 1997); and as mentioned earlier, costs associated with the Red River flood of 1997 are estimated to be $400 million. These numbers underscore the need for effective floodplain management.

2.3 Flood management in Canada

2.3.1 Structural and non-structural measures

Flood management measures include structural and non-structural measures. Structural measures can be divided into flood control works and flood protection works (Askew, 1991). Flood control works include dams and reservoirs, and channel diversions. Dams and reservoirs are used to capture runoff and release it gradually. Some examples of dams and reservoirs used to control floods in Canada include the reservoirs on the Bridge and Stave Rivers in British Columbia and the Shellmouth Dam on the Assiniboine River in Manitoba. Channel diversions such as the Portage Diversion in Manitoba and the Nechako River Diversion in British Columbia, redirect all or part of river flow away from threatened areas (de Loe, 2000).

Flood protection works include dikes and levees. These are used to protect specific parcels of land, especially in already developed floodprone areas (de Loe, 2000). For example, in British Columbia, dike construction has been the historic method of containing floods in the lower Fraser Valley (Environment Canada, 1993). In Manitoba, the Winnipeg diking system, which consists of earth dikes and pumping stations, is used to protect property from floodwaters (EPC, 1999).

Non-structural measures to reduce or prevent flooding include a range of activities aimed at keeping flood-vulnerable development out of floodplains and shorelines. These activities include the flood proofing of vulnerable structures, the physical relocation of houses and other structures from the floodplain to safer areas, and the application of land-use controls such as zoning (de Loe, 2000).

An important example of a land-use control strategy used to prevent flooding in