FLOOD RISK PERCEPTION IN THE RED RIVER BASIN, MANITOBA: IMPLICATIONS FOR HAZARD AND DISASTER MANAGEMENT

BY

MICHAEL E. OLCZYK

A Thesis submitted to
The Faculty of Graduate Studies
In Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

A key element in hazard and disaster management is awareness of how stakeholders perceive risk. The primary goal of this study is to examine flood risk perception and its role in decision-making in relation to hazard and disaster management in the Red River Basin, Manitoba, Canada. The specific study objectives are to: 1) assess the nature of perceived risk at both the local and organizational levels; 2) determine if there is any variation between perceived risk among flood area residents and institutional experts; 3) identify various factors that influence perceptions of risk and decision-making processes at the local level; and 4) examine the variations in flood area residents' perceptions of risk and flood-related issues based on their geographical location.

In order to achieve the objectives of the study, the research methods selected were qualitative in nature. A modified Delphi Process was utilized to solicit subjective, informed judgments from residents and decision makers in the basin. The Delphi Process involved two methods: 1) face-to-face interviews, and 2) a two-round mail-out Delphi survey. A sample (non-representative) of 42 respondents was divided into two separate groups, Flood Area Residents and Institutional Representatives. Flood Area Residents were divided into Winnipeg (urban) and South (rural) respondents and Institutional Representatives were divided into Senior, Local, and Non-Government respondents.

The study findings established that while an element of variation in perceived risk between flood area residents and institutional experts does exist, it is not as significant as postulated in the literature. Residents' perceptions were based on subjective factors, but many exhibited a general awareness of objective risk. Perceptions of institutional experts responsible for managing risk involved some degree of value judgments and an element

of subjectivity as well. The gap that did appear to exist between the two groups was associated with a lack of understanding and communication. The study findings also indicated that a number of factors have influenced residents' perceptions of risk. The most notable factors were the geographical location of Winnipeg and South respondents and the influence of large-scale structural mitigation measures. Other influencing factors identified were: past flood experience, uncertainty, and visual presentation of the flood.

The research exemplified that the inclusion of perceptions of risk is pivotal to decision-making processes. For example, a lack of communication to residents regarding policy changes to evacuation procedures since 1997 could have considerable implications for future flood response (i.e. public opposition). Within the City of Winnipeg the reduction in physical risk and sense of security afforded by the Floodway has attenuated the perceptions of risk of some respondents and potentially made them more vulnerable to extreme flood events. The Floodway Expansion project may exacerbate this situation by increasing the level of physical protection. In addition, past flood experience heightened the awareness of some respondents and will serve as the context for future perceptions; uncertainty amplified risk-related anxiety for some respondents and could potentially increase stress in future floods; and visual presentation of the flood heightened perceptions of risk for some respondents and in some cases also influenced behaviour.

With an enhanced understanding of risk perception, institutional experts and decision makers will be better able to establish and implement proactive mitigation and preparedness strategies that are sustainable and improve resiliency. One of the keys to this inclusion is a two-way communication process that involves learning on both sides.

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INTRODUCTION

1.1 – The Problem of Flooding in the Red River Basin

The primary goal of this study is to examine flood risk perception and its role in decision-making in relation to hazard and disaster management in the Red River Basin, Manitoba, Canada. The research will address four specific objectives. The first objective is to assess the nature of perceived risk at both the local and organizational levels. The second objective is to determine if there is any variation between perceived risk among flood area residents and institutional experts. The third objective is to identify various factors that influence perceptions of risk and decision-making processes at the local level. The fourth and final objective is to examine the variations in flood area residents' perceptions of risk and flood-related issues based on their geographical location.

The Red River Basin occupies sizeable parts of North Dakota, northwestern Minnesota, southern Manitoba, and a small part of northeastern South Dakota (see Figure 1). The basin covers approximately 45,000 square miles (116,500 square kilometres) of land, excluding the Assiniboine River Basin, and drains into Lake Winnipeg in Manitoba (IJC, 2000b). The main component of the basin is the Red River Valley, "a 17,000-square mile [44,000 square kilometre] piece of incredibly flat real estate" (Krenz and Leitch, 1993, p.1). The valley is as a remnant of glacial Lake Agassiz and is the flattest part of the basin. At its widest point the valley spans 60 miles (95 kilometres) across and extends for 315 miles (500 kilometres) in length (Krenz and Leitch, 1993). The focal point of the valley is the Red River, which forms in Wahpeton, North Dakota with the convergence of the Bois de Sioux and Ottertail Rivers and flows northwards through a

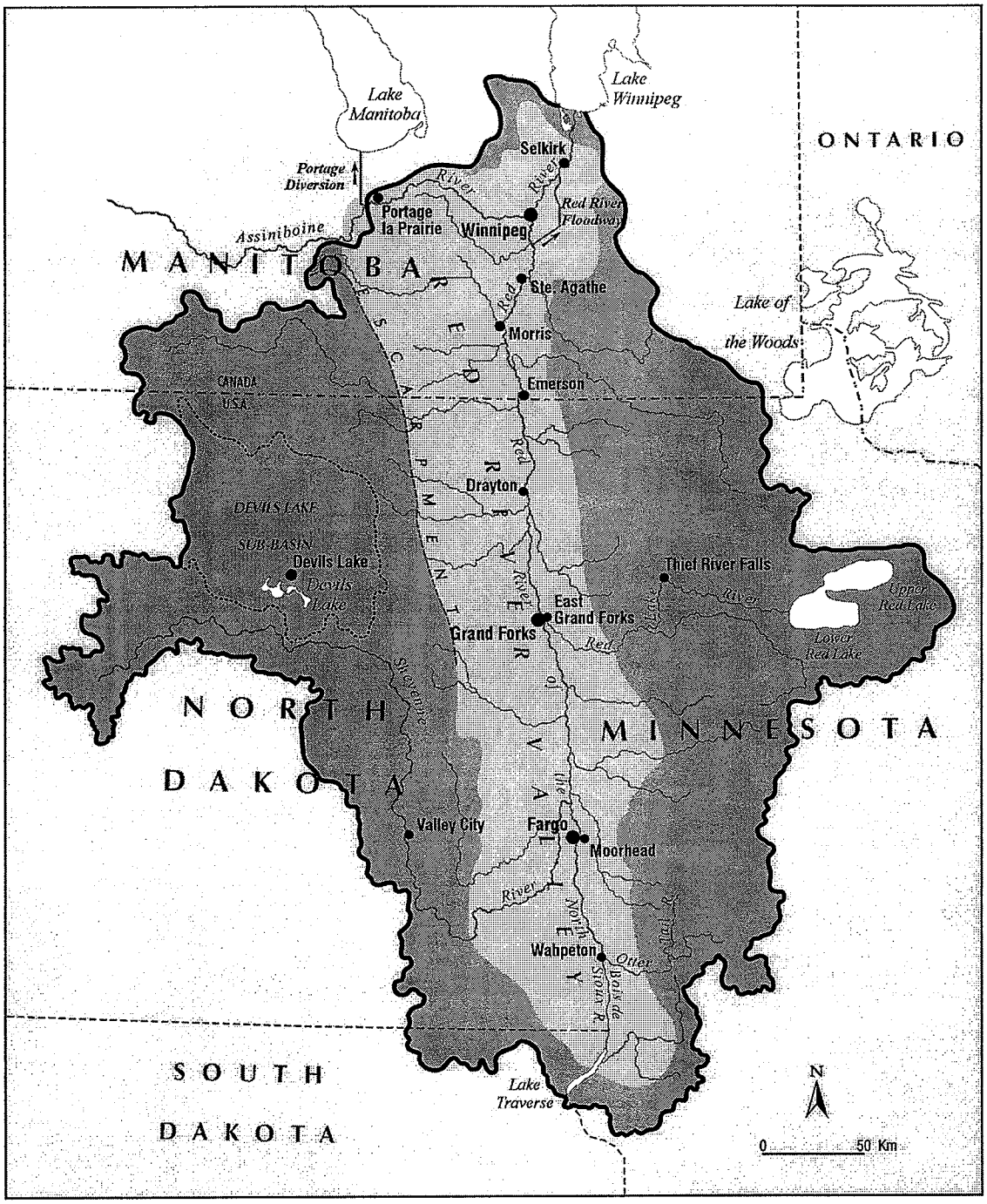


Figure 1: Map of the Red River Basin (Source: Weldon Hiebert, University of Winnipeg, 1993)

pattern of meanders until it empties into Lake Winnipeg. The flatness of the basin is illustrated by the northward slope of the river, which is variable and averages less than one-half foot per mile. Flows in the river are erratic and highly variable, ranging from periods of virtually no flow to extremely high flows that create flood conditions.

Flood conditions are a natural process in the region and have a regular historical occurrence. "The floodplain has clay soils with low absorptive capacity that can contribute to flood problems ... [and] the river's northward flow increases the potential for ice jams and resultant backwater flooding" (IJC, 2000b, p.9). Historical floods deposited fine silts throughout the floodplain and helped make the valley "one of the most productive agricultural areas in the world" (Krenz and Leitch, 1993, p.1). This was one of the primary factors that attracted human settlement to the banks of the river in the early 19th century and led to the development of major urban centres, including Winnipeg (population 670,000), Fargo-Moorhead (population over 100,000), Grand Forks-East Grand Forks (population 60,000), and Selkirk (population 9,800) (IJC, 2000b). Due to the location of settlements and the physical characteristics of the valley, both rural and urban residents are exposed to flood risk whenever river flow exceeds channel capacity.

The seriousness of flood risk in the region became clearly evident in 1950 when settlements throughout the valley, including major portions of Winnipeg, were inundated and experienced considerable devastation from flooding. High water levels forced nearly 80,000 residents to evacuate Winnipeg and resulted in more than 9,000 building damage claims (Bumsted, 1993). "It was estimated that over 2,000 dwelling places in greater Winnipeg had been flooded over the first-floor level" (Bumsted, 1993, p.85). Moreover, 40,000 residents throughout southern Manitoba were evacuated and approximately 2,500 premises experienced flood damage (Bumsted, 1993). The estimated total cost of the flood to the province in 1950 was approximately $42 million (Bumsted, 1993).

Due to these exorbitant losses, the provincial and federal governments formed the 'Royal Commission on Flood Cost-Benefit' in the aftermath of the flood. The purpose of

the Commission was to recommend flood prevention and mitigation options that would ensure Winnipeg and southern Manitoba communities would never again experience such devastation (Haque, 2000). Based on recommendations from the Commission, the government in power implemented a number of structural mitigation measures to control floodwaters in the valley. Flood control works, completed by the early 1970s, included: the Red River Floodway, Portage Diversion, and Shellmouth Dam and Reservoir, as well as the primary dike system within the City of Winnipeg and the community ring dike system around settlements in the valley. These flood control works prevented widespread devastation from significant flood events in 1974, 1979, and 1996.

However, the spring of 1997 brought a magnitude of flooding that surpassed the levels associated with the devastating flood of 1950. In fact, in 1997 floodwaters reached levels that had not been experienced since 1852. At its peak the Red River expanded to cover more than 710 square miles (1,800 square kilometres) and created an inland sea that was 25 miles (40 kilometres) across at its widest point (see Figure 2) (Haque, 2000; IJC, 2000b). The province's flood control works were pushed to their maximum capacities by the massive spring runoff. The largest of these works, the Red River Floodway, diverted floodwaters around Winnipeg and prevented any significant damage within the City. Throughout the rest of southern Manitoba there was widespread devastation from the floodwaters. Significant damage occurred in the area immediately upstream of the Floodway Inlet and many residents lost their homes. Additionally, the village of Ste. Agathe, situated on higher ground and historically safe from floodwaters, was flooded by overland flow and many individual homes throughout the valley were also inundated and destroyed as temporary sandbag and earthen dikes were breached.

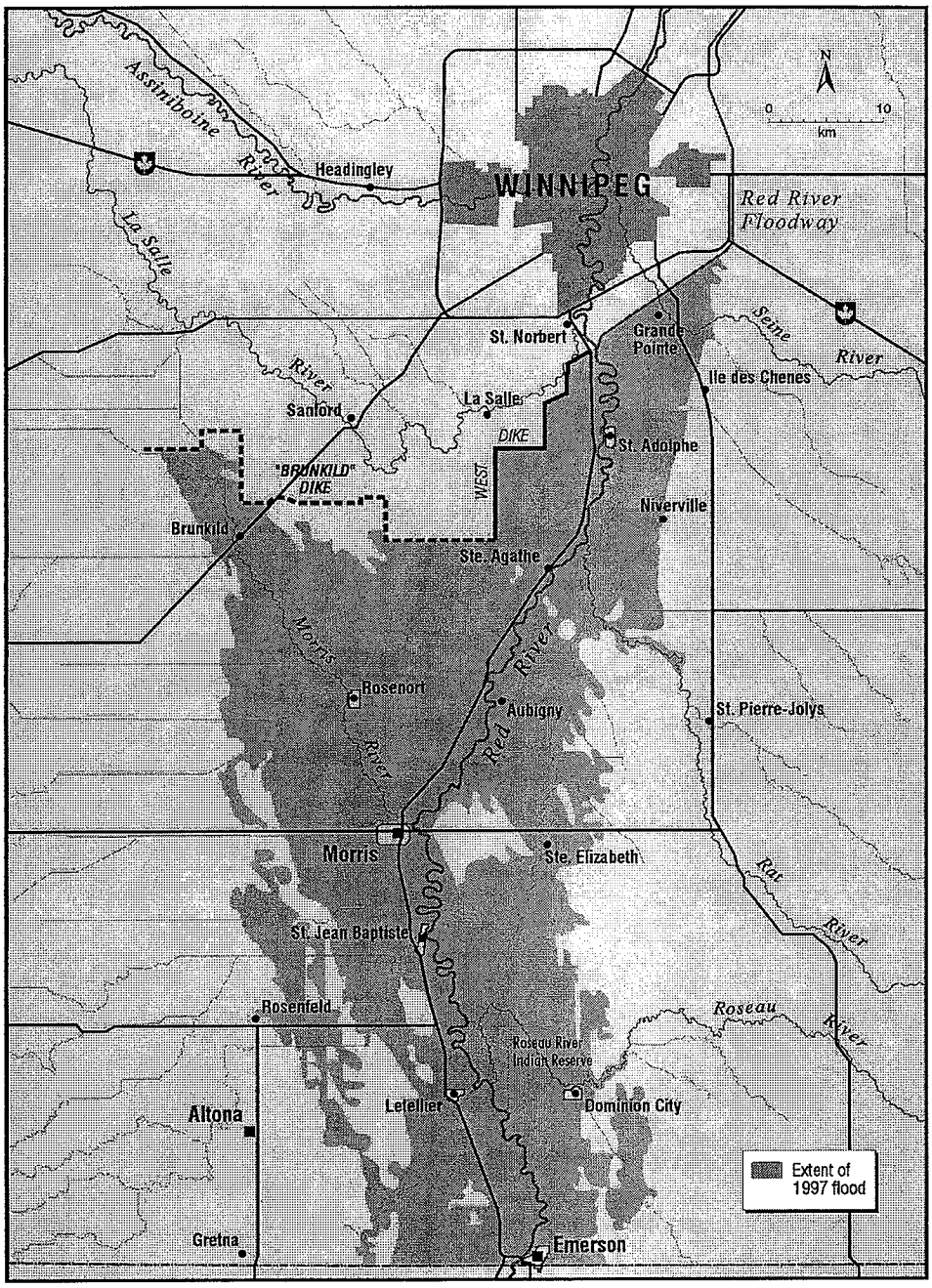


Figure 2: The Extent of Overland Flooding During the 1997 Red River Flood
(Source: Weldon Hiebert, University of Winnipeg, 1997)

Thus, while the flood control works and temporary mitigation measures performed admirably in some areas of the valley, many areas were devastated. The estimated total cost in the province for the catastrophic damages and resources expended fighting the 1997 flood was on the order of $500 million and as a result the disaster was

labelled the 'Flood of the Century' (MWC, 1998). This figure would have been much higher if the flood had been larger and the Floodway unable to save Winnipeg. Consequently, at the request of the governments of Canada and the United States, the International Joint Commission (IJC) established an International Red River Basin Task Force to investigate the causes and effects of the 1997 flood and make recommendations on measures to reduce the impacts of future floods. The Task Force made it clear in their post-flood report that the basin remains at undue risk from floods larger than 1997. "A flood equal to the flood of record in 1826 could lead to the evacuation of at least 300,000 people and cause damages of as much as $5.8 billion" (IJC, 2000a, p.41).

As indicated by the Task Force, the occurrence of a flood larger than 1997 is not merely a possibility, it is a physical certainty. Analysis of historical records and scientific evidence has proven the existence of floods larger than 1997 that will recur within a given time period. The primary uncertainty surrounding these larger floods is precisely determining the year and the season in which they will recur. Therefore, it is pivotal that communities in the basin address their vulnerabilities as soon as practically possible. The majority of the evacuations and a significant proportion of the damages resulting from an 1826 magnitude flood would stem from inundation of parts of Winnipeg. Flood control works were pushed to their limits in 1997 and a number of weaknesses in the City's flood defence system became apparent. In 1997, ring dike communities throughout the basin, such as Morris and Emerson, had water reach near to the top of their dikes; these towns would be extremely vulnerable in the event of an 1826 magnitude flood, as would many of the individual rural homes that were destroyed in 1997 and rebuilt on floodpads (hills) or behind dikes equivalent to 1997 flood levels plus two feet of freeboard.

1.2 – Disaster and Flood Research

A common trend among hazard and disaster management practices during the 20th century has been the dominance of a scientific or technocratic viewpoint, focused primarily on the physical processes of disasters. This 'dominant viewpoint,' as Hewitt (1983) refers to it, recognizes that the potential threat posed by a hazard requires the presence of a vulnerable human population to turn a situation into a disaster. The problem with this view lies in "the sense of causality or direction of explanation … [that] runs from the physical environment to its social impacts" (Hewitt, 1983, p.5). According to Hewitt (1983), the dominant view functions based on the assumption that social factors are a dependent variable and have no effect on the physical processes of a disaster event.

The dominant view served as the basis for the majority of research and policy development until the pioneering works of Gilbert White began to identify human dimensions as a fundamental consideration in disaster events. Seminal works by scholars such as Ian Burton, Robert Kates, Thomas Saarinen, E.L. Quarantelli, Dennis Mileti, Kenneth Hewitt, and many of their colleagues challenged the technocratic notion and laid the groundwork for theories that integrated social processes into the explanation of disasters. The one-dimensional disaster model that focused solely on physical agents was refuted and it was suggested that disasters are outcomes of an interface where social human factors and natural physical processes interact.

While academics may have recognized the importance of human dimensions in disaster studies, many decision makers and practitioners still function under the premise of a scientific ethos. Hazard and disaster management at the community level has been somewhat limited and local stakeholders have not been effectively included in the policy

process. The prevalent style of management has been a top-down or command-and-control approach where government representatives make the decisions, often without taking into account the values and perceptions of the local residents.

The emergency phase of the 1997 Red River flood clearly illustrated the limitations of a command-and-control approach. Emergency management practices that employed a top-down approach were problematic because they generally overlooked the social aspects of the flood disaster. While flood control works were effective in reducing the costs associated with the disaster, the narrow focus on engineering solutions reduced the coping ability and resilience of many local residents whose homes were impacted. As a result, numerous conflicts and psychosocial impacts developed during the response and recovery phases of the flood. Researchers such as Morris-Oswald and Simonovic (1997), Buckland and Rahman (1999), Haque (2000), and Rasid et al. (2000) identified these issues and impacts – including: resource equity, post-flood recovery, compensation, information communication, stress, and mandatory evacuation – and determined that they were not adequately addressed in 1997 and have remained problematic.

Additionally, the International Red River Basin Task Force recognized this oversight of social aspects by the responsible authorities during the 1997 flood, stating, "many issues have not yet been studied, and more research is needed before the immediate and long-term social effects of the Red River flood can be fully understood" (IJC, 2000a, p.68). The lack of knowledge concerning social issues is clearly illustrated by the fact that in their April 2000 report the Task Force recommendations centred mostly on structural mitigation measures (greater than seven pages) and very little on non-structural mitigation measures (only one page) that could contribute to reduced

vulnerability in future floods. As a result, the IJC, in their November 2000 report, recommended that, "to improve resiliency in the basin, governments should support enhanced research into the various social dimensions of the flood, including economic, psychological, public health and sociological impacts" (IJC, 2000b, p.37).

As such, it is imperative that decision-making authorities in the basin address the social aspects of flood disasters and work towards long-term risk reduction. "Disaster marks the interface between an extreme physical phenomenon and a vulnerable human population. It is of paramount importance to recognise both of these elements. Without people there is no disaster" (O' Keefe et al., 1976, p.566). The inclusion of social aspects in decision-making is essential to increase the resilience of residents and create sustainable hazard and disaster management practices; human responses and the characteristics of vulnerable populations play a pivotal role in disasters. This is because "[t]he severity and form of damages [from a disaster] depend primarily upon the pre-existing state of society and its environmental relations" (Hewitt, 1997, p.22).

1.3 – The Role of Risk Perception

A crucial step in the inclusion of social aspects is to understand how different stakeholders perceive risk. "Perception of a hazard is an individual's understanding of the character and relevance of a hazard for self and/or community" (Mileti et al., 1975, p.23). An assessment of risk perception is vital in the discernment of the social state of a community. "The idea of 'risk' conveys a fuller sense of ... [disasters], in that it embraces exposure to dangers, adverse or undesirable prospects, and the conditions that contribute to danger" (Hewitt, 1997, p.22). As such, an awareness of risk perception will provide decision makers with insight into the impetus for individual and community

response and behaviour during disaster events; thus enhancing hazard and disaster management. "Those who promote and regulate health and safety need to understand the ways in which people think about and respond to risk" (Slovic, 1987, p.280).

Mileti (1980) defines risk perception as the "cognition or belief in the seriousness of the threat of an environmental extreme, as well as the subjective probability of experiencing a damaging environmental extreme" (p.336). The cognitions, beliefs, and subjective probabilities that determine how an individual perceives a stimulus, such as a disaster, are influenced by a number of factors. As such, the concept of risk perception is quite broad; "risk events interact with psychological, social, and cultural processes in ways that can heighten or attenuate public perceptions of risk and related risk behavior" (Kasperson et al., 1988, p.178/79).

Existing literature asserts that a gap exists between experts' estimation of risk (based on objective or quantitative probabilistic assessments) and those of the public (based on qualitative assessments that involve a diversity of factors beyond fatality rates) (Cutter, 1993). Two of the primary factors contributing to this divergence are the persistence of a technocratic dominant view and the influence of psychological, sociological, and anthropological principles on individual decision-making. "When laypeople are asked to evaluate risks, they seldom have statistical evidence on hand. In most cases they must rely on inferences based on what they remember hearing or observing about the risk in question" (Slovic et al., 1979, p.15).

Douglas and Wildavsky (1982) reasoned that sociocultural processes were working to govern the selection of risks (why some are emphasized and others ignored). According to Short (1984), individual responses to hazards are strongly mediated by the

social fabric at risk, i.e. social influences transmitted by friends, family, co-workers, and respected public officials often provide after the fact rationale for hazard behaviour (Slovic, 1987; Cutter, 1993). In sum, Cutter (1993) clarified that "the cultural selection of risk was not linked to objective risk measurements or the physical reality of risk. Rather the selection of risk reflected moral, political, economic, and power positions that were all value-laden and culturally constructed" (p.22).

When laypeople evaluate danger they seldom use statistical evidence, rather they rely on inferences based on what they hear or observe about the situation. By utilizing general inferential rules in situations wrought with uncertainty, laypeople make decisions in a boundly rational manner. "Knowledge of the workings of bounded rationality forms a basis for understanding constraints on decision-making and suggests methods for helping the decision maker improve as an adapting system" (Slovic et al., 1974, p.200). Laypeople use these rules, termed heuristics, to reduce difficult mental tasks into simpler, more manageable tasks. The four primary rules identified in the literature are the availability heuristic, representativeness heuristic, anchoring and adjustment heuristic, and affect heuristic. The problem herein is that these heuristics are subject to large and persistent biases when they are used to make sense out of an uncertain world. "People respond to the hazards they perceive. If their perceptions are faulty, efforts at public and environmental protection are likely to be misdirected" (Slovic et al., 1979, p.14).

1.4 – Research Purpose and Objectives

This study was part of a larger research project titled "Flood Research Partnership (FRP): Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin." The project was funded by the Social Sciences and Humanities

Research Council of Canada (SSHRC) under the Community-University Research Alliance (CURA) program and involved partners from five universities (Manitoba, Brandon, Lakehead, Western Ontario, and Simon Fraser), three rural communities (Rural Municipalities of Morris and Ritchot, Town of Emerson), and a government organization (formerly Water Resources Branch, Manitoba Conservation). The project was interdisciplinary in nature and involved four areas of investigation: 1) risk perception and risk communication; 2) individual and community value systems; 3) public involvement in floodplain management decision-making; and 4) integration of risk perception and social value systems in an operational multi-criteria decision-making framework.

I was a graduate student member of a five-person research team that investigated the risk perception and risk communication topic area (referred to as the risk management module). Within the risk management module decisions were made in collaboration as a team but individual researchers were responsible for a particular theme. My responsibility was concentrated on the risk perception theme and I conducted background research and provided input for this part of the module. Specific tasks included: establishing the research design and study area, delineating and ascertaining the respondent sample, designing the research instruments, collecting and analyzing the primary data. While I contributed to the overall process as a team member, the module was designed so that each individual researcher's objectives, data, and analytical findings did not overlap and could be easily delineated within the module.

The primary goal of this study is to examine flood risk perception and its role in decision-making in relation to hazard and disaster management in the Red River Basin. Research of this nature is required because flood disasters are part of life for residents

living along the Red River and the level of risk remains high; a flood equivalent to or larger than 1997 could realistically happen in any year (IJC, 2000a). A key intention of this study is to involve local residents who have experienced flood events and to gain an understanding of their views and perceptions. "In the places where disaster has occurred, our enquiries can be informed by the experience and concerns of survivors, those who have been 'at the sharp end' of these dangers" (Hewitt, 1997, p.21).

To ensure that community resiliency and sustainability are upheld, decision makers and responsible authorities need to have an awareness of the potential implications that their decisions may have prior to implementation. "No single expert has a prerogative on knowing what kind of development, or response to hazard, is "right." Local people, laymen, individuals may have knowledge unavailable to the "expert": they will certainly have different frames of reference" (Whyte, 1986, p.241). An informed decision maker, aware of diverse viewpoints and perceptions on an issue, will be apt to make better judgments in hazard and disaster management decision-making. The specific objectives of the research are to:

1) Assess the nature of perceived risk at both the local and organizational levels.
2) Determine if there is any variation between perceived risk among flood area residents and institutional experts.
3) Identify various factors that influence perceptions of risk and decision-making processes at the local level.
4) Examine the variations in flood area residents' perceptions of risk and flood-related issues based on their geographical location.

1.5 – Research Design and Methods

To achieve the objectives of this study it was necessary to conduct a thorough review of the pertinent literature. Topic areas reviewed included the nature of objective flood risk and human geography in the Red River Basin, environmental hazards and

subjective risk perception, and the Delphi technique. The research design is qualitative in nature and based on a framework developed during the ***Workshop on the Application of the Delphi Technique to Sustainable Floodplain Management***, held on August 28-29, 2002 at the Natural Resources Institute, University of Manitoba.

This study involves 42 respondents divided into two separate groups: Flood Area Residents and Institutional Representatives. A modified Delphi Process is utilized to solicit subjective, informed judgments from local residents and institutional experts in the basin. The Delphi Process involves two methods: 1) face-to-face interviews, and 2) a two-round mail-out Delphi survey. Multiple methods are utilized for the purposes of triangulation, as per advice from Bardecki (2002) and directions from existing literature (Van Dijk, 1990; Mitchell, 2002). Data were analyzed in three stages as part of roundtable meetings with the risk management module research team. Chapter 3 provides greater detail with regard to the research design and methods used in this study.

1.6 – The Nature of Flood Risk (Objective) in the Red River Basin

1.6.1 – Historical Settlement and Establishment of Colony

The first permanent settlers to plough the fertile soils of the Red River Valley were of Scottish descent and arrived in 1812 to occupy river lots. The immigrants settled at the 'Selkirk Colony' site, near what is now Winnipeg, and by the spring of 1826 were introduced to the first major flooding on the Red River (since their arrival) that forced them to abandon their river dwellings and move to higher ground to seek protection (Krenz and Leitch, 1993). The cultural landscape along the Red and Assiniboine rivers, pre-1870, was based on a land survey system that divided the land into long narrow farm lots fronting on the rivers (Kaye, 1996). This settlement pattern produced a continuous

line of riverfront farmsteads that resembled a long suburban village (Kaye, 1996). "One characteristic of the straggling village was that the various community services and facilities were usually not concentrated in one location but were scattered at different places on the long lines of settlement" (Kaye, 1996, p.87).

A transportation corridor developed between the Selkirk Settlement and what is now St. Paul, Minnesota; accordingly a number of permanent settlements emerged as links in the transportation network. The original corridor consisted of Red River cart trails that had branches on both sides of the Red River and was of central importance in terms of stimulating settlement in the upper basin. Steamboats replaced the cart trails and carried a variety of trade goods on the Red River for 53 years (Krenz and Leitch, 1993).

While the cart and steamboat played important roles in settlement, it was the arrival of the railroad that enhanced settlement of the basin. The railway provided integral contributions to increased settlement as the trade link between the lower Red River Valley and St. Paul, but also because the railways had land to sell and promoted the valley extensively (Krenz and Leitch, 1993). "For the most part, settlers remained bound to the lifeline of timber or the railway" (Lehr, 1996, p.95). With an increasing volume of trade being conducted along the corridor the village of Winnipeg, with 'the Forks' as the central place, emerged as the dominant urban centre (Kaye, 1996).

After 1870, the long-lot survey system was abandoned for a township system, similar to that employed in the United States, which had square surveyed sections with road allowances (Richtik, 1996). "The net effect of the surveying system was to disperse settlement and produce a checkerboard pattern in agricultural areas; the ubiquity of roads permitted houses to be anywhere" (Richtik, 1996, p.103). Immigration from diverse

cultural interests also contributed to the dispersed pattern of settlement and resulted in the creation of villages throughout the province (Lehr, 1996). During this time of increased settlement, agriculture was one of Manitoba's most important industries and was integral to the provincial economy and the growth of the province (Haque, 1997).

The early 20th century brought a decline in the amount of arable land available and consequently immigrants moved in large numbers to Winnipeg (Haque, 1996). This trend continued throughout the 20th century as Winnipeg expanded to include greater than 50% of the total provincial population (Haque, 1996). "With increased diversification of the non-agricultural economy on the one hand, and the uncertainty of the farm economy on the other, many people ... left their traditional place of rural residence and moved into, or close to, the major city" (Haque, 1996, p.113). Despite economic diversification and a decrease in the number of farms, agriculture has remained an important industry in Manitoba and continues to be a significant part of the provincial economy.

This particular trend of urbanization concentrated a significant proportion of Manitoba's population within a single urban centre (Winnipeg) and also in the smaller urban centres throughout the southern portion of the province. Another recent trend has been the emergence of bedroom communities. While there has been a continued decline in population in rural areas, the rural municipalities in areas close to Winnipeg have experienced an increase in population (Haque, 1997). This urban-rural fringe has been a region where rural residents have moved to be nearer to the urban centre and urban residents have moved to escape the urban centre. Infrastructure and urban amenities have been provided in rural settings that are perceived as more enjoyable, less costly, and within commuting distance of the larger urban centre.

Associated with these population concentrations are stark differences in the type and extent of flood risk for residents in the basin that depend on location. For instance, in Winnipeg – the economic backbone of the province with vast amounts of expensive infrastructure – the risk is collectively shared among a large number of people. On a smaller scale, residents living in the cities, towns, and villages in the basin also share the risk as a collective. In contrast, there are individual rural homes interspersed throughout the basin where homeowners independently face the risk.

1.6.2 – The Significance of Historical Flood Data

One of the most important research areas contributing to the knowledge base on flooding is the analysis of historical flooding. Rannie has combined existing research based on proxy data (i.e. tree-rings, the incidence of forest fires, diatom-based salinity records, river or lake ice conditions, etc.) with his own work based on archival records. Using observations recorded in the Manitoba and Hudson's Bay Company Archives, Rannie (1999a) compiled a database of archival materials that made specific reference to river conditions, especially those that detailed unusually high or low water levels and the accompanying weather conditions that produced them. Specifically Rannie (1999b):

a) compiled a complete list of flood occurrences from 1793 to 1870;
b) categorized annual runoff conditions in the watershed; and
c) surveyed the 19th [century] climate of the watershed as it relates to the hydrologic environment (p.4).

Rannie (1999b) suggested that climate in the 19th century was quite different from modern climate in many respects, primarily because it marked the end of the Little Ice Age, a cooler and wetter climatic period. The different climatic regimen would have subjected the basin to different predominant circulation patterns and climatic norms compared to those experienced currently (Rannie, 1999a). The Red River is particularly

sensitive to changes in climate due to its location on the periphery of a bioclimatic region where even small changes can result in major boundary shifts (Rannie, 1999a). "The basin lies aside the transition from humid forested regions in the east to subhumid and semiarid conditions to the west, receiving runoff from both" (Rannie, 1999a, p.1).

There are many documented cases of changing climatic conditions and subsequent ramifications during flood events. One important change relates to freezeup and breakup dates of ice on the Red River. Rannie (1999b) noted that average freezeup dates in the 19th century occurred 12 days earlier than in the 20th century and overall the fall season was about 2.5° C colder in the former. Rannie (1999b) also noted that average breakup dates in the 19th century were 10 days later than in the 20th century and overall the spring season was about 2.5° C colder in the former (see Table 1). In concurrence with data pertaining to precipitation and runoff, these observations indicate the important role climate change has played in river hydraulics (i.e. reduced periods of ice cover).

Table 1: Average Breakup Dates, Red River at Winnipeg, 1821-1980

	Average	Latest Date		Average	Latest Date
1821-1840	April 18	May 8	1901-1920	April 11	April 25
1841-1860	April 20	May 6	1921-1940	April 6	April 20
1861-1880	April 26	May 3	1941-1960	April 11	April 23
1881-1900	April 22	May 2	1961-1980	April 15	April 26

Source: Adapted from Rannie, 1999b, p.12.

According to Rannie (1999a), the basin is especially sensitive to small variations in precipitation, evapotranspiration, and/or land surface conditions because the runoff ratio for the basin is quite low. Any increase in precipitation could have significant implications for flooding due to the associated increase in average runoff levels. The hydrological consequences of changes to the land cover by drainage networks (built since

the turn of the century) are complex and poorly understood, but do play a role in flooding on the Red River (Rannie, 1999a).

> The artificial drainage systems served a twofold purpose: to increase the area of arable land and to remove surface water more rapidly in the spring, both of which would increase the runoff ratio in comparison with the natural landscape. In addition, because the gradients toward the river are greater than the downstream gradient of the Red River itself, it is likely that water is delivered to the main river more quickly than it can be removed (Rannie, 1999a, p.22).

Rannie (1999a) concluded that conditions in the 19th century were characteristic of a 'wetter' hydroclimatic period, with higher average runoff and more frequent flooding than in the 20th century. It is imperative to note that "the implied flood frequency in the 19th [century] is somewhat greater than that of the 20th [century] but comparable to that from 1948 to the present" (Rannie, 1999b, p.1). The first half of the 20th century was relatively dry and markedly different from the flood conditions that prevailed in the 19th century. The second half of the 20th century has reflected flood conditions quite similar to those experienced in the 19th century with significant flood events in 1950, 1966, 1979, 1996, and 1997; suggesting a trend in the latter half of the 20th century that is reflective of the trend present throughout most of the 19th century.

In addition to the three large historical events most frequently cited – 1826, 1852, and 1861 – Rannie's contributions led to the understanding of major flood events that took place in 1811, 1825, and 1850. Much of the literature also makes reference to a massive flood in 1776 that was greater in magnitude than 1826, the largest flood on record. Based on insufficient scientific data, a precise objective magnitude for the 1776 flood has not been determined, thus excluding it from probabilistic calculations; if a value is ever determined this flood may significantly affect return period calculations.

The "use of historic data assures that estimates fit community experience and improves the frequency determinations" (USWRC, 1982, p.5). Improved frequency determinations provide researchers with the ability to make more accurate calculations of return periods for floods of given magnitudes. For instance, in 1962 the flood protection works for Winnipeg (Red River Floodway, Portage Diversion, Shellmouth Dam) were intended to provide protection for the city up to a design flood of 169,000 cfs (KGS Group Main Report, 2001). Based on the hydrological data available in 1962, the design flood was calculated to have a return period of 1 in 160 years (KGS Group Main Report, 2001). "The current design flood return period, based on today's knowledge of the hydrology of the Red River, is approximately 1 in 90 years" (KGS Group Main Report, 2001, p.8). A refinement in the calculations resulted in a decrease in the return period of the design flood, essentially indicating that floods of this magnitude can be expected to occur more frequently than previously thought. "Historic flows are important in estimating the flood threat" (Hardin, 1999, p.7) because they help increase the accuracy for the design flood calculation (in this case decreasing the return period) by increasing the size of the data set. The calculations for design floods need to be as accurate as possible because this value is the standard that flood protection works are based on.

Additionally, while it is possible to model streamflow based purely on climatic drivers, it is not likely to be accurate if no hydrometric data are available for the purposes of calibration and validation; therefore, recorded (historical) flood data plays an integral role in the development of meaningful runoff and flood forecasting methodologies (Warkentin, 2002). The Hydrologic Forecast Centre of Manitoba Water Stewardship uses recorded streamflow data, through the use of event models, as a means to develop

relationships between the causal parameters of a flood and the runoff or peak flows that occur (Warkentin, 2002). Recorded flows and river levels are very important for the calibration of the flood routing models used in Manitoba and for real-time forecasting as they indicate the state of various watersheds and thus enable shorter term forecasting of streamflows (Warkentin, 2002). The following section details Manitoba's flood forecasting methodologies; it is pivotal to keep in mind that an essential component in the accuracy of flood forecasting is the presence and accuracy of recorded historical data.

1.6.3 – Flood Forecasting Procedures in Manitoba

The element of risk for a springtime flood in any given year depends on certain preceding conditions. Rannie (1999a) identified five typical causal factors associated with the formation of large spring floods:

i) an abnormally wet late summer and fall period which saturates the ground prior to freezeup;
ii) severe cold and freezeup prior to the first significant snowfall to permit frost to penetrate deeply;
iii) a cold winter with heavy snow over the entire watershed and minimal thawing, producing a heavy standing snowpack at the end of winter;
iv) a late spring, which slows the release of snowpack water, followed by a rapid transition from sub-freezing to melting temperatures; and
v) above normal late-winter precipitation near the breakup period or during the melt period. This may occur as a heavy late winter snowfall or significant rainfall during the period of flood formation.

Another important element associated with these causal factors is timing. Causal factors play an important role in forecasting because when they occur collectively near their maximum values, the probability for a major flood is quite high (Warkentin, 1999).

Flood forecasting is an important tool aiding in the reduction of the danger that residents face. Accurate forecasts provide residents with knowledge regarding the volume of discharge and the level of water, along with the timing and duration of stay.

This knowledge is beneficial in helping residents make important decisions such as whether or not they need to move personal belongings out of their homes or prepare for evacuation. Forecasting also provides residents with a guideline for dike construction through the provision of tangible values indicating how high their dikes need to be for adequate protection, thus affecting the risk they face. For instance, if a resident were to construct a dike to an elevation based on an underestimated forecast, their level of danger is increased if water levels are higher and a dike is overtopped while they are on site.

The methodologies employed in Manitoba for springtime flood forecasting involve three aspects: runoff forecasting, streamflow forecasting, and river stage forecasting. Forecasting for spring runoff volume involves "an index type of model to predict the runoff volume and peak discharge for the Red River at Emerson" (Warkentin, 1997, p.6). Specifically, the model is an Antecedent Precipitation Index (API) that is lumped both spatially and temporally and follows parameters associated with the aforementioned causal factors (Warkentin, 2002). Those parameters are:

1. soil moisture at freeze-up;
2. water content of the snowpack;
3. melt rate;
4. effective spring rain;
5. observed spring runoff volume; and
6. timing (Warkentin, 1999; Warkentin, 2002).

According to Warkentin (1997), the index model for forecasting relies on statistical relationships for the U.S. part of the Red River watershed and considers the entire area as one basin for computational purposes.

> Relationships of runoff versus the causal parameters are derived from analysis of all the spring runoff events for the period of record. These relationships are depicted either in graphical form or as formulas derived from statistical analysis of product-power type functions (Warkentin, 2002, p.1).

The API is based on the weighted monthly precipitation between May and October and is used to represent the autumn soil moisture content at freeze-up (Warkentin, 1997). "This may be modified somewhat based on other estimates of soil moisture at freeze-up obtained from airborne gamma surveys and/or modeled soil moisture" (Warkentin, 2002, p.1). There are various procedures used to determine the water content of the snowpack: cumulative precipitation, airborne gamma techniques, satellite microwave maps of snowcover, and conventional snow surveys. Cumulative winter precipitation includes the effective spring precipitation, a degree-day type of melt index for melt rates, and the winter temperature index, used to approximate sublimation losses and soil temperatures (Warkentin, 1997). The runoff volumes from past events for the watershed are estimated based on daily flow data obtained from the Water Survey of Canada (Warkentin, 2002).

> Preparation of runoff outlooks involves inputs for future weather conditions as well as for existing basin conditions. Estimates of additional precipitation and melt rates for various probabilities are obtained from duration curves based on the past 40 years of data. Runoff is predicted by applying real time basin parameters together with selected future conditions to graphical or statistical relationships. For flood outlooks, forecasts are usually prepared for three future weather conditions, namely for the lower decal, median and upper decal conditions. For operational forecasts (when runoff is underway) normal future weather is usually assumed unless otherwise noted. When preparing the forecasts, some adjustments are made for factors not accounted for by the above parameters, such as soil frost and large-scale changes in drainage or land use. These are done on a qualitative basis based on available research (Warkentin, 2002, p.2).

According to Warkentin (2002), streamflow forecasting methodologies involve taking predicted runoff volumes and converting them into hydrographs (using unit hydrographs) that indicate the daily flows at specific points in the watershed. Using data from past events provides the basis for the preparation of unit hydrographs for slow, moderate, and fast melts. Warkentin also noted that this method is quite successful for

lumped watershed inputs, i.e. a well defined melt period, but becomes problematic for non-uniform inputs, i.e. a melt interrupted by a cold spell. When non-uniform inputs occur the forecast becomes reliant upon good judgment relating to the indicators mentioned earlier, i.e. streamflow reports and snowcover reports (Warkentin, 2002).

"Streamflow forecasting for large rivers requires channel routing to account for the effects of channel and overbank storage, time of travel, and timing of runoff from various portions of the watershed" (Warkentin, 2002, p.2). Along the Red River, flood routing was originally performed for areas between Emerson and Winnipeg and after 1997 was extended south to Halstad, Minnesota. The Muskingum routing procedure is used for both outlooks and operational forecasts and originally involved taking the daily-predicted flows at Emerson and routing them together with the daily-predicted flows for thirteen tributaries in the Manitoba portion of the basin, including the Assiniboine River (Warkentin, 1997). After 1997 this process remained the same, aside from an expansion into the U.S. portion of the basin to allow for greater accuracy of the forecasts. By using real-time data on soil moisture, snow water content, precipitation amounts, and other measured variables, the runoff volume and timing for each tributary can be calculated and predictions of stage and discharge for given locations along the river can be made.

The U.S. National Weather Service (NWS) introduced a new probabilistic flood forecasting procedure for the U.S. part of the basin in 2001. This new strategy is beneficial for the Canadian part of the basin as the NWS provides predicted peak flows and stages for all percentiles from 1 to 99 (Warkentin, 2002). These predictions provide an adequate representation of flows coming from the U.S. and coordinate well with Manitoba Water Stewardship's 10, 50, and 90 percentile forecasts (Warkentin, 2002).

River stage forecasting involves taking the routed peak flows (obtained using the Muskingum procedure) and converting them into stage values with the use of rating tables or river-slope relationships (Warkentin, 2002). River stage forecasting provides the predicted height of the water surface for specific locations along the river and provides communities with an understandable numeric figure. The flood of 1997 was so expansive that overland flooding extended onto the floodplain up to a maximum width of 25 miles (40 kilometres) in Manitoba; this revealed a limitation in the forecasting methodologies. One drawback to the Muskingum procedure, noted by Warkentin (1997), is the inability to make predictions of floodwater levels on the floodplain at a distance from the river channel. Based on this limitation and the conditions in 1997, forecasters were unable to provide local residents living in homes built away from the primary channel with predictions of peak river stages. Overall, in 1997 the forecasts released by the Water Resources Branch were quite accurate for certain areas of the basin.

> [Figure 3] provides a summary of the forecasting results for selected locations along the Red River. The various bars illustrate the difference between the median forecast and the actual water levels at the selected locations for each of the forecast dates. For operational forecasts, the median forecast has been taken as the midpoint of the forecast range. Negative values on the graph represent an under prediction of the actual water level while positive values indicate that the water level was forecasted to rise higher than it actually did. As can be seen, the forecast errors generally decrease in magnitude for the later forecast periods, as expected. Also, the magnitude of the forecast error is larger for the more northerly locations with the maximum forecast error occurring immediately upstream of the [Red River Floodway] inlet (MWC, 1998, p.76).

The key to success is a forecaster with experience, who can make sound judgments and accurate predictions. Fortunately for Manitoba the Hydrologic Forecast Centre (formerly known as the Manitoba River Forecast Centre), in the Water Branch of Manitoba Water Stewardship, can adequately fill this demanding and crucial role.

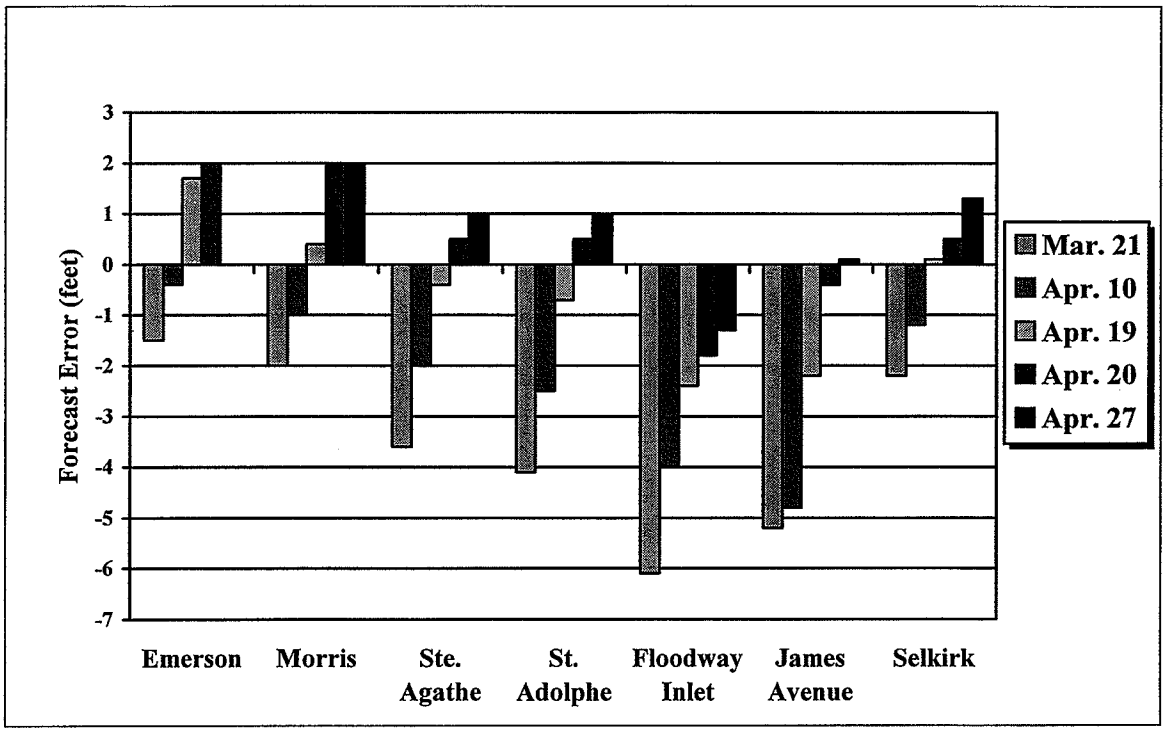


Figure 3: Forecast Error for 1997 Red River Water Levels (Source: Adapted from MWC, 1998, p.76)

After 1997, the IJC conducted intense studies on how to best prepare the basin for future flood events. One of the developments related to this research was the implementation of Mike-11, a dynamic flood routing procedure that is calibrated from Grand Forks to Selkirk (Warkentin, 2002). The Mike-11 routing procedure provides forecasters with the ability to calculate water levels away from the immediate river channel and should close the gap that existed in 1997. According to Warkentin (2002), while the new routing system appears to have excellent potential it has yet to be tested operationally, therefore the Muskingum procedure will still be used during the next flood as a failsafe to ensure the routed discharges from Mike-11 are accurate.

The three forecasting methodologies are utilized jointly in the preparation of flood outlooks, issued monthly from January through March each year. Once spring runoff begins in the basin the forecasts become dependent upon predictions from the NWS for the Red River at Pembina, North Dakota (Warkentin, 1997). The U.S. forecast is integral

because 80 percent of the total runoff for the Red River originates in the U.S. part of the basin. Flood condition sheets are released in accordance with the commencement of spring runoff and are released daily along with forecast reports during flood conditions. The forecasts released by the Water Branch consist of various components that explain the different elements of a prediction; such as a synopsis of the conditions and the percent chance that flooding will occur in the given year. In addition to the new routing procedure, the Water Branch has also introduced a decision-support system based on a Geographical Information Systems platform that was not available in 1997. The system is intended to "provide residents of the valley and flood fighters easy access via [the] internet to predicted water levels, property levels, and calculations of how many sandbags will be required to protect their properties" (Warkentin, 2002, p.3).

1.6.4 – The Valley at Risk

The IJC Task Force report of April 2000 stated that a flood of the magnitude of 1997 will happen again and it could be as large as or larger than the flood of 1826. For comparison, in 1997 "the peak calculated natural flow at the Forks was 163,000 cfs [and] the flow during the 1826 flood is estimated to have been 225,000 cfs" (IJC, 2000a, p.17). Based on current hydrologic knowledge, a flood equivalent to the magnitude experienced in 1826 would overwhelm the reliable capacity of Winnipeg's flood control works (see Table 2) and as mentioned earlier, result in the evacuation of at least 300,000 residents and cause up to $5.8 billion in damages (IJC, 2000a). "The current reliable capacity of the Winnipeg flood protection works has a 37 percent probability of being exceeded at least once in the next 50 years" (IJC, 2000a, p.45). This is in reference to a 1 in 100 year event that has a one percent probability of occurring each year.

"The term *recurrence interval* (also called the *return period*)...is the time which, on average, elapses between two events which equal or exceed a particular level" (Wilson, 1982, p.182). The recurrence interval of a given flood can be determined through frequency analysis. Frequency analysis uses "the methods of statistics to extend the available data and hence predict the likely frequency of occurrence of natural events" (Wilson, 1982, p.180). When "given adequate records, statistical methods will show that floods of certain magnitudes may, on average, be expected annually, every ten years, every 100 years and so on" (Wilson, 1982, p.180). The Water Branch uses a widely accepted procedure for frequency analysis that is based on the parameters delineated in U.S. Water Resources Council Bulletin 17B. The log-Pearson Type III distribution, fitted by moments, is a three-parameter distribution including the mean, standard deviation, and co-efficient of skew (a measure of the curvature of the frequency curve) that produces excellent results for the Water Branch (Hardin, 1999).

Table 2: Capacities of Winnipeg's Flood Protection Systems

Component	Design capacity	1997	Reliable capacity
Shellmouth Reservoir	7,000 cfs	4,000 cfs	7,000 cfs
Portage Diversion	25,000 cfs	11,900 cfs	25,000 cfs
Red River Floodway	60,000 cfs	67,100 cfs	73,000 cfs
River Channel	77,000 cfs	80,000 cfs	71,000 cfs
Totals	**169,000 cfs**	**163,000 cfs**	**Up to 176,000 cfs**

Source: Adapted from IJC, 2000a, p.44.

"The accuracy of estimation of the value of the (say) 100 yr flood depends on how long the record is and, for flood flows, one is fortunate to have records longer than 30 years" (Wilson, 1982, p.181). As discussed previously, a longer historical record produces a more accurate estimated return period, thus illustrating the importance of historical research. "Frequency analysis can be of great value in the interpretation and assessment of events such as flood flows and the risks of their occurrence in specific time

periods" (Wilson, 1982, p.181). A flood of a given magnitude does have the probability of occurrence in any particular time period under consideration (Wilson, 1982).

The IJC identified 57 ways in which Winnipeg would be vulnerable to inundation if a flood larger than 1997 were to occur. These were reduced into eight categories:

1. **Overall Flood Protection System.** These vulnerabilities include limitations on the overall capacity of the flood control system, inadequate detailed emergency preparedness and response plans, floodplain development that limits flexibility and may affect public safety, and flood monitoring concerns.
2. **Red River Floodway Inlet Structure.** If the embankments near the inlet structure erode or fail, floodwaters could bypass the inlet. The control system could fail in ways that would make it impossible to control gates – for example, fire in the inlet structure. Other issues include damage from ice, debris, or sabotage, and the need for clarity and understanding of the operating rules.
3. **Red River Floodway Channel.** Bridge failures could restrict the Floodway capacity. The embankments could fail. A failure of the Seine River Syphon could breach the West Embankment of the Floodway and allow an uncontrolled flow of up to 15,000 cfs (425 cms) to enter the city from the Seine River. Many services, such as water and electricity, are vulnerable under certain circumstances as they cross the Floodway channel, but that risk appears low.
4. **West Floodway Embankment.** If any portion of the first three miles (4.8 km) of the West Embankment (between the Floodway itself and the city) is breached, an uncontrolled flow of water would enter the south or east side of Winnipeg.
5. **West Dike.** Failure of the West Dike (the long dike extending from the Floodway Inlet Structure toward the town of Brunkild) through wind action, overtopping, or other causes would lead to uncontrolled flows into south Winnipeg by way of the La Salle River.
6. **Flood Protection Infrastructure within Winnipeg.** The city itself is subject to a number of internal vulnerabilities. These relate to the primary and secondary diking systems and to the flood-pumping stations and floodgate chambers. When river levels are high, floodwater can enter the city through the storm water or sanitary sewer system. There is no guarantee that the many temporary measures taken during the 1997 flood would be as successful again, even for a flood of the same magnitude.
7. **Portage Diversion.** The major threat is that the break-up of ice jams upstream of the diversion reservoir could cause a surge of ice and water and damage the system. Failure of the system for any reason could reduce the flow diverted to Lake Manitoba and hence increase flows toward Winnipeg.
8. **Shellmouth Dam.** The gates could fail, or the dam could breach or fail from erosion. While a Shellmouth dam failure would have severe consequences immediately downstream, the effect on flood protection levels in Winnipeg would be relatively minor (IJC, 2000a, p.42/43).

Based on these significant vulnerabilities and the associated risks they represent, an engineering firm, the KGS Group, was given a contract by the provincial government to study the feasibility of flood protection options for Winnipeg. "The design flood used as the standard for flood protection works for Winnipeg should be the highest that can be economically justified or, at a minimum, the flood of record, the 1826 flood" (IJC, 2000a, p.46). To meet this requirement, the project determined to be most feasible is an expansion of the Floodway that would provide protection up to a 1 in 700 year flood, well above 1826 levels that are approximately equivalent to a 1 in 300 year flood.

Location is an essential element for risk assessment in the valley as some areas are more vulnerable to flooding and consequently, have a higher level of risk than other locations. For instance, "river ice can cause property damage, erode stream banks, disrupt transportation and hydropower operations, and make flood forecasting difficult" (IJC, 2000a, p.33). Ice jams are a significant threat for residents in the communities downstream of the Floodway outlet. In 1996, a large ice jam caused flooding in portions of Selkirk and in the region downstream to Breezy Point where many individual homes exist. These problems arise due to the fact that, as indicated earlier, the Red River is northward flowing river and a significant proportion of the basin will thaw and produce runoff before the mouth of the river has had a chance to unfreeze and break up. Often large volumes of water arrive in the north region carrying blocks of ice that dam up and create a reservoir that poses a significant danger to the region upstream of the blockage.

Individual homeowners throughout the valley face a different level of flood risk than residents living within the confines of the Floodway or community ring dikes. Individual homes in the valley are hidden behind earthen dikes or elevated on large hills

(floodpads) as a means to protect them in the event of flooding. Community ring dikes provide small towns and villages with the ability to bear the risk mutually rather than having each household bear the risk individually. Whereas, individual homeowners on the rural areas are not part of a collective group and must solely bear the risk they face.

Residents living in the area immediately upstream of the Floodway suffered increased flooding during the 1997 flood due to an operating rule that was implemented to provide increased protection for Winnipeg. In emergency conditions the Floodway Operating Rules allow for the raising of upstream water levels above the state of nature to protect Winnipeg. "The Floodway could operate reliably beyond its 60,000 cfs design capacity to handle 73,000 cfs. Consequently, water levels upstream of the Floodway inlet would rise above natural levels" (IJC, 2000a, p.43). Associated with this increase in water levels is an increase in risk for upstream residents, specifically increased chances of dike failure if they were not constructed with consideration for additional water.

Another element of risk present in the valley pertains to the communities that are protected by ring dikes. Communities such as Emerson and Morris have ring dikes that held back floodwaters in 1997 and have since been raised to an elevation of 1997 flood levels plus two feet of freeboard. A primary concern for these communities is the possibility of dike failure due to overtopping, seepage, or improper closure at road and rail entrances through the dike. Evacuation reduces the danger to human life in the event of dike failure, but the threat to property remains significant within the confines of the dike. Other communities, such as Ste. Agathe, did not have a permanent ring dike in 1997 and were severely damaged by floodwaters. Provisions have since been made and projects undertaken to construct ring dikes for the remaining at-risk communities.

CHAPTER 2

CONCEPTUAL CONSIDERATIONS: A REVIEW

2.1 – Risk Perception: The Nature of Perceived Risk

2.1.1 – Introduction

"The perception of risk is multidimensional, with a particular hazard meaning different things to different people (depending for example on their underlying value systems) and different things in different contexts" (Royal Society, 1992, p.89). As such, contributions to understanding in the field of risk perception have come from researchers of various disciplines including: geography, psychology, sociology, and anthropology. According to a report on risk by the Royal Society in 1992, the principal challenge facing researchers in these disciplines has been finding a means to integrate their various streams of work together to formulate a clear representation of risk perception and the role of contrasting theories.

The interdisciplinary nature of risk perception research progressed in the 1960s and 1970s with independent work by geographers and psychologists concerning the physical consequences of hazards, cognitive psychology, and the study of human decision-making behaviour (Royal Society, 1992). Subsequently, by the early to mid-1980s those involved with the social sciences expressed concern that the nature of anthropological, sociological, and political science relevance to risk-related issues was misrepresented and misunderstood (Short, 1987). Previous research in cross-cultural analyses had identified social mechanisms as a determinant of individual risk perceptions (Cutter, 1993) but these analyses did not receive wider acceptance. An increased focus on risk perception research by sociologists and anthropologists led to acknowledgment of

social, cultural, and political processes as integral factors in the formulation of individual attitudes towards risks and their acceptance (Royal Society, 1992).

2.1.2 – Risk Measurement at the Individual Level: Research in Psychology and Geography

Early psychological research by Slovic et al. (1974) utilized pre-existing theories of bounded rationality, put forth by Simon (1956) and Kates (1962), to explain how laypeople make decisions and adjustments in the context of natural hazards. The theory of bounded rationality maintains that laypersons do not think probabilistically and that they attempt to avoid the necessity of directly facing uncertainty (Slovic et al., 1974). In effect, when making decisions in the face of uncertainty laypeople are constrained by cognitive limitations that lead them to create simple decision models, rather than following a rational decision-making process. People have a desire for certainty and as such, whenever possible, "attempt to reduce the anxiety generated in the face of uncertainty by denying that uncertainty, thus making the risk seem either so small that it can safely be ignored or so large that it clearly should be avoided" (Slovic, 1986, p.405).

Based on the characteristics of bounded rationality, other psychological theories, and findings from empirical studies, researchers were able to identify an existing gap between experts' estimation of risk and those of the public (Cutter, 1993). Objective risk, utilized by experts, can be defined as "the probability of a future event calculated from statistical data provided by past events" (Burton and Pushchak, 1984, p.469). An expert divides risk into three separate components to calculate risk estimates in a rational manner – i) *an estimate of probability,* ii) *a time period to which the probability applies,* and iii) *the consequences measured in deaths, injuries, or damage* (Burton and Pushchak, 1984). A standard definition of risk was developed in accordance with the expert's

objective calculation; risk is "the product of hazard (the physical agent and its impact) and vulnerability (the susceptibility to damage or injury)" (Alexander, 1997, p.291).

The problem for community level decision makers (i.e. laypeople or the public) lies in the fact that this definition is conceptually based on the dominant view. The expert's notion of risk does not account for the social dimensions of hazards and is a contributing factor to the existence of the aforementioned gap. Laypersons view risk more subjectively, as indicated by the theory of bounded rationality. "Perceived risk is an assessment of the probability of an event and its consequences arrived at subjectively by individuals" (Burton and Pushchak, 1984, p.469). Perceptions are influenced by a number of different psychological, sociological, and cultural factors and depend on the specific hazard event under consideration. "No matter how good our science may be, it will not resolve the major difficulty we face; that is, the great discrepancy between scientific and public perception" (Burton and Pushchak, 1984, p.469). To provide sustainable hazard and disaster management, decision makers must be aware of how the public perceives risk and the factors that influence these perceptions.

"Efficient adjustment to natural hazards demands an understanding of the probabilistic character of natural events and an ability to think in probabilistic terms" (Slovic et al., 1974, p.191). Yet, problems exist because when people make judgments regarding uncertain events they may not follow the principles of statistical theory on probability. Rather than applying the accepted rules for estimating probabilities, people tend to replace the laws of chance with intuitive heuristics (Slovic et al., 1974). These heuristics, or mental strategies, are general rules that people use to reduce the difficult task of estimating probability and frequency into more simple judgments to aid decision-

making (Slovic et al., 1974; Carlson et al., 2000). In some instances heuristics may be suitable, but in others they may lead to large and persistent biases that have serious implications for decision-making (Slovic et al., 1976). Often times, subjective probability estimates are distorted by these systematic biases, which can be difficult to eliminate (Tversky and Kahneman, 1973). There are four heuristics that have been defined in the literature and their features are discussed in the subsequent sections.

2.1.2.1 – The Availability Heuristic

The availability heuristic is one general rule that individuals use to reduce the difficulty of discerning probability estimates that influence their decision-making. The availability heuristic involves an individual judging the probability of an event based on "the ease with which relative instances are imagined or by the number of such instances that are readily retrieved from memory" (Slovic et al., 1974, p.194). Frequent events and likely occurrences are much easier to recall or imagine than are infrequent events and more unlikely occurrences (Slovic et al., 1974). Thus, the features of an event that an individual is able to think of most easily are deemed more important and the individual will perceive the recurrence of that event to be more frequent (Carlson et al., 2000).

Additionally, the "memory of salient natural events seems to begin with an extreme event, which effectively blots out recall of earlier events and acts as a fixed point against which to calibrate later points" (Slovic et al., 1974, p.194). This concept is readily apparent in the Red River Basin; although major flooding occurred in 1950, 1979, and 1996, it was an extreme event in 1997 that has since been the reference point for policy changes and research studies (e.g. MWC, 1998; Haque, 2000; IJC, 2000b).

Subtle factors such as recency and emotional saliency are independent of the actual frequency of an event, but are related to the availability heuristic and play a role in influencing perceptions (Slovic et al., 1974). "The availability hypothesis implies that any factor that makes a hazard highly memorable or imaginable – such as a recent disaster or film or lecture – could considerably increase the perceived risk of that hazard" (Slovic et al., 1974, p.195). For instance, a phenomenon called priming occurs when recent exposure to a particular type of event makes it easier to think of other examples relating to that event (Carlson et al., 2000). The emotional saliency of an event can influence the importance of the event in the decision-making process; a dramatic personal encounter is much more available and memorable than a set of statistics and as such, tends to have a disproportionate effect on people's behaviour (Carlson et al., 2000).

Contrary to the suppositions of some policy makers, even intelligent individuals may not have accurate perceptions about the frequency of the hazard events to which they are exposed (Slovic et al., 1976). Problems exist because systematic biases and distortions in judgment can result from the use of mental availability factors as cues for individual estimations of probability and frequency (Slovic et al., 1974). "Factors that increase the availability of instances should correspondingly increase the perceived frequency and subjective probability of the events under consideration" (Slovic et al., 1974, p.194); direct experience with an event or indirect exposure to an event via the media can significantly influence judgments (Slovic et al., 1976).

A practical example of potential bias can be seen in regards to the perception of flooding described by Kates (1962): floodplain inhabitants generally perceive a risk from flooding only to the extent or magnitude that they have previously experienced, thus

leaving themselves vulnerable in the event of larger floods. Based on such observations, Kates (1962) concluded that individuals have an inability to conceptualize floods that they have never experienced. The memorability of past events plays an important role in the determination of how individuals will perceive and react to future events; "the biasing effects of memorability and imaginability may pose a barrier to open, objective discussions of risk" (Slovic et al., 1979, p.15).

2.1.2.2 – The Anchoring and Adjustment Heuristic

Another general rule that individuals employ to reduce the difficulty of making probability estimates is the anchoring and adjustment heuristic. This heuristic involves individuals utilizing a natural starting point for their first estimation of a judgment (the anchor) and then making further judgments by adjusting this position based on supplementary information (Slovic et al., 1974). "Typically, the adjustment is a crude and imprecise one which fails to do justice to the importance of additional information" (Slovic et al., 1974, p.195). As such, subsequent perceptions tend to remain anchored to the original perception and it is unlikely further information will adjust perceptions significantly (Burton and Pushchak, 1984). These biases can have serious implications for decision-making; i.e. "an individual's intuitive estimates of the size of a flood that would be exceeded only one time in one hundred will be conservative (i.e., too close to his estimate of the "most-likely" flood magnitude), and he thus would allow too small a margin of safety in his protective adjustments" (Slovic et al., 1974, p.196).

2.1.2.3 – The Representativeness Heuristic

The representativeness heuristic is a general rule for decision-making that is based on an individual's ability to classify information into a category in which it appears to be

most familiar (Carlson et al., 2000). "Lay persons establish the probability of an event by assuming it is representative of another better known event" (Burton and Pushchak, 1984, p.470). The experiences of life provide individuals with the knowledge that some characteristics are associated and go together; when one of these characteristics is observed, individuals assume that others are also present (Carlson et al., 2000). For instance, when meeting someone for the first time one typically notices characteristics such as clothing and hairstyle. Then, based on personal experience, one generally makes an intuitive assumption about the other characteristics of the person (that may not be readily apparent) and attempts to match the observable characteristics of that person to the different stereotypes in one's mind (Carlson et al., 2000). The majority of the time this strategy is effective in producing accurate predictions, but sometimes it can be misleading and serve as a source of cognitive distortion (Carlson et al., 2000).

2.1.2.4 – The Affect Heuristic

Affect is "an orienting mechanism that directs fundamental psychological processes such as attention, memory, and information processing" (Slovic, 1997, p.292). Affective reactions are often an individual's first response to a stimulus, occurring before more extensive perception and cognitive characteristics guide information processing and judgment (Slovic, 1997). For example, an individual does not simply see 'a house'; rather, they see a 'nice house' or an 'ugly house' (Slovic, 1997). "Affect may be viewed as a feeling state that people experience, such as happiness or sadness … [and] may also be viewed as a quality (e.g. goodness or badness) associated with a stimulus" (Finucane et al., 2000, p.2). Slovic (1997) asserted that affect and worldviews are functionally similar and serve as orienting dispositions that aid individuals in navigating more

efficiently through a complex and uncertain world. For instance, laypersons' perceptions of risk, acceptance of risk, and trust in risk management institutions are generally determined by knowledge and experience. Worldviews (see section 2.1.3.1) and affect exist as the overarching phenomena (see figure 4) that influence the knowledge and experience determinants utilized by laypeople (Slovic, 1997).

The affect heuristic is an essential component in many forms of judgment and decision-making; people mark images with positive and negative affective feelings and then consult this 'affective pool' to guide their judgment and decision-making (Finucane et al., 2000). "Just as imaginability, memorability, and similarity serve as cues for probability judgments, affect may serve as a cue for many important judgments" (Finucane et al., 2000, p.3). Finucane et al. (2000) suggest that the affect heuristic is utilized by individuals when required judgments are complex or mental resources are constrained – the affect heuristic is an easier, more efficient mental short-cut in comparison to cognitive processes that retrieve examples from memory.

An example illustrating the importance of affect in decision-making can be derived from risk-benefit analysis. "Although risk and benefit may be positively correlated in the environment, numerous studies have shown them to be negatively related in people's minds" (Finucane et al., 2000, p.3). People perceive an inverse relationship between risk and benefit, where the greater the risk, the lower the benefit and the lower the risk, the greater the benefit. Based on research conducted by Alhakami and Slovic (1994), it was suggested that the reason people create these inverse relationships in their mind is because they refer to an affective feeling when judging risks or benefits for hazards. Alhakami and Slovic (1994) concluded that when people liked an activity they

judged it to have low risk and high benefit, and conversely when they disliked an activity they judged it to have high risk and low benefit (Finucane et al., 2000).

Further research by Finucane et al. (2000) determined that "reliance on the affect heuristic seems to be exposed more clearly when people's opportunity for analytic deliberation is reduced and an efficient mode of judgment is needed" (p.8). Thus, in circumstances where time is a constraint and cognitive processing is difficult, individual decision makers will rely on affective processes to make quick judgments. The affect heuristic is a motivator of individual behaviour and is effective for illustrating another bias that influences people when they are making decisions (Finucane et al., 2000).

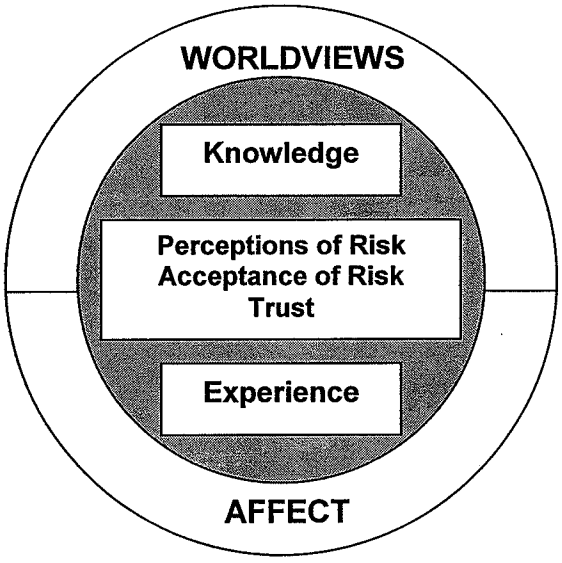


Figure 4: Model of Worldviews and Affect as Orienting Dispositions
(Source: Adapted from Slovic, 1997, p.295)

2.1.2.5 – Further Biases and Aspects of Heuristics

As mentioned earlier, experts and laypeople have divergent perceptions when it comes to judging the risks associated with hazards. One of the contributing factors in this divergence is laypersons reliance on heuristics that are fallible. The general rules that

individuals utilize to reduce the uncertainty of decision-making have inherent biases that are commonly apparent. For instance:

> [o]nce formed, initial impressions tend to structure the way that subsequent evidence is interpreted. New evidence appears reliable and informative if it is consistent with one's initial belief; contrary evidence is dismissed as unreliable, erroneous, or unrepresentative. Thus, depending upon one's predispositions, intense effort to reduce a hazard may be interpreted to mean either that the risks are great or that the technologists are responsive to the public's concerns. Likewise, opponents of a technology may view minor mishaps as near catastrophes and dismiss the contrary opinions of experts as biased by vested interests (Slovic et al., 1979, p.37).

Another apparent perceptual bias is that people tend to be typically overconfident about the judgments they make based on heuristics; people do not realize the limits to their knowledge and that much additional information is required to sufficiently understand risk (Slovic et al., 1979). "People think that they can estimate ... values with much greater precision than is actually the case" (Slovic et al., 1979, p.17). The result is that there can be a great deal of error and bias in the judgments that people make. This limitation of heuristics and subjective judgments can make it difficult for experts who discover new information and try to inform laypeople about alternative perspectives.

> [The] rarity of catastrophic events makes it extremely difficult to resolve disagreements by recourse to empirical evidence. Demonstrating the improbability of catastrophic [events] requires massive amounts of data. In the absence of definitive evidence, weaker data tend to be interpreted in a manner consistent with the individual's prior beliefs. As a result, the "perception gap" between ... experts and the ... public is likely to persist, leaving frustration, distrust, conflict, and costly hazard management as its legacy (Slovic et al., 1980, p.208).

As described previously, frequency estimates are a key determinant in the perception of risk by laypeople. Additionally, laypeople also take into account certain qualitative characteristics when judging risks associated with particular activities. Some of these characteristics include whether or not the risk is: involuntary in nature, unknown,

uncontrollable, unfamiliar, potentially catastrophic, dreaded, or severe in consequence (Slovic et al., 1979). Further research by Slovic (1986) also identified equity and threat to future generations as accompaniments to this list.

These characteristics play a role in determining the signal values that influence the public's perception of risks. The signal potential or informativeness of a specific event is related to the characteristics of the event and the hazard it exhibits; much of the seriousness and higher-order impacts of an event are determined by what it signifies or indicates (Kasperson et al., 1988). "An accident that takes many lives may have little or no impact on perceived risk if it occurs as part of a familiar, well-understood and self-limiting process" (Slovic et al., 1980, p.209). In contrast, if a smaller accident were to occur in an unfamiliar and poorly understood process, perceived risk may be greatly enhanced and it may trigger strong corrective actions due to an increase in the judged probability of future accidents (Slovic et al., 1980).

A pertinent example would be the vast impacts that resulted from the accident at Three Mile Island. While the accident caused no immediate fatalities, its signal value increased the perceived risk of nuclear reactors on a global scale (Slovic et al., 1980). Hazards representing risks that are judged to be uncertain, dreaded, or catastrophic also tend to be judged most in need of strict government regulation (Slovic et al., 1987). For instance, a technological accident can serve as a signal that a company is not properly managing risks. This signal event can trigger a strong societal reaction, such as public opposition or litigation, which can inflict costs on the company (Slovic et al., 1987).

"Public awareness of risks is heavily influenced by media coverage" (Short, 1984, p.720/21). The mass media often serves as the primary source of information about risk

for laypeople and as such, has the ability to exert a powerful influence on public perceptions (Slovic, 1986). Accordingly, a fundamental consideration for risk analysts is the accuracy of the information presented in the media. "Content analysis of media reporting for specific hazards ... and the domain of hazards in general ... has documented a great deal of misinformation and distortion" (Slovic, 1986, p.410). Slovic (1986) determined that journalists often report incorrect or misleading interpretations of scientific fact that misinform the public and result in an overreaction to certain risks.

In addition to the accuracy of information reported, the mass media tend to influence risk perceptions and attitudes through the coverage of news topics. The frequencies of events that receive heavy media coverage are generally overestimated and the frequencies of events that receive little or no coverage are generally underestimated (Slovic et al., 1976). Hazard incidents that represent the 'un-ness' described by Hewitt (1983) tend to get most of the media coverage because they are perceived as unknown, unfamiliar, dreaded, and potentially catastrophic. The mass media focus on the negative qualitative characteristics that influence perceptions. As such, since these events receive more media coverage than familiar inconsequential incidents, they stand a greater chance of influencing perceptions because they will be more easily retrieved from memory (Slovic, 1986) – i.e. the availability heuristic. People tend to overestimate the frequency of dramatic and sensational events that involve deaths (which receive extensive media coverage) and underestimate unspectacular common events that involve single victims or non-fatalities (which receive minimal media coverage) (Slovic et al., 1979; Short, 1984).

Consequently, the evident fallacies that influence public perceptions of risk have produced considerable reaction from experts (Slovic, 1987). Experts have deemed the

public as irrational and foolhardy because their perceptions are flawed and their decision-making process subject to misguided judgments; when in fact, "experts themselves are not immune to biases of judgement" (Royal Society, 1992, p.107). Slovic et al. (1979) determined that experts can be as susceptible to overconfidence as laypeople and identified four ways in which experts may overlook or misjudge the pathways to disaster:

i) failure to consider the ways in which human errors can affect technological systems;
ii) overconfidence in current scientific knowledge;
iii) insensitivity to how a technological system functions as a whole; and
iv) failure to anticipate human response to safety measures (p.17).

As such, from an experts' perspective the public cannot be viewed as irrational because they rely on qualitative inferential rules to aid decision-making during uncertainty. Laypeople use these rules to reduce difficult mental tasks into simpler, more manageable tasks; precisely the process that experts follow when science falls short and they are forced to rely on personal judgment. As the role of judgment increases in expert decision-making, the results tend to become gradually more subjective (Fischhoff et al., 1983). "The psychometric tradition has undoubtedly generated an impressive body of empirical data on individual risk perceptions. The evidence shows that human judgements of hazards and their benefits involve multiple qualitative dimensions related in quite subtle and complex ways" (Royal Society, 1992, p.107).

2.1.3 – The Societal and Cultural Context: Research in Sociology and Anthropology

In their seminal work Risk and Culture, Douglas and Wildavsky (1982) questioned the resolve of utilizing a scientific ethos to analyze why certain risks are perceived differently than others. The authors put forth that cultural theory has an important role to play in the determination of risk perception. The authors argued that

risks are socially selected as each culture and each set of shared values and supporting social institutions are biased toward highlighting certain risks and downplaying others (Douglas and Wildavsky, 1982). In addition to challenging the scientific ethos, the hypotheses of Douglas and Wildavsky reaffirmed the belief that an analysis of risk perception needed to go beyond the suppositions of the psychometric approach.

Similarly, in his 1984 Presidential Address on behalf of the American Sociological Association, J.F. Short Jr. decried the failure of risk analysts to include sociological concerns in their research. Short (1984) claimed that risk analysis had been too narrowly focused on scientific processes that do not address the things that people value. As such, Short (1984) proposed that a social transformation of risk analysis needed to take place through an examination of the social fabric at risk. The social fabric ranges "from interpersonal processes and networks to social institutions and structures, from primary groups and symbolic interaction to social movements and large-scale organizations and systems" (Short, 1984, p.711).

Consequently, a number of sociological and anthropological researchers who supported these notions became involved and a transformation occurred as broader social concerns were incorporated into risk perception research. The incorporation of broader social concerns increased the understanding of risk perception and risk behaviour by detailing the importance of social, cultural, and institutional processes.

> The perceiver of risk is rarely an isolated individual, but a 'social being' who necessarily lives and works, plays and rests, within networks of informal and formal relationships with others. Such relationships are manifest in a wide range of both small- and large-scale social and institutional arrangements within and across societies. These arrangements set constraints and obligations upon people's behaviour, provide broad frameworks for the shaping of their attitudes and beliefs, and are also closely tied to questions both of morality and of what is to be valued and what is not (Douglas, 1985; Royal Society, 1992, p.111).

Any suitable analysis of risk perception and behaviour must involve elements from the psychological approach, as well as from the sociological and anthropological approaches.

> It is an assumption in much of sociology and anthropology that one of the things that people value most (and which shapes their perceptions and behaviour) will be the set of social arrangements or institutions that they personally strongly identify with or participate in. In the context of risk perception therefore, the hazards that are likely to be of particular concern are those that pose threats to locally valued social and institutional arrangements, or to other elements that are central to a particular way of life (Royal Society, 1992, p.112).

Thus, as Short (1984) suggested, balanced risk analyses need to address the social and cultural context of hazards and risks, the determination of what is at risk, the perception of risk, and the acceptability of risk.

2.1.3.1 – Cultural Theory

Anthropologist Mary Douglas and her colleagues pioneered the 'grid-group' cultural theory that challenged the standard psychological approach to risk perception (Royal Society, 1992). The central tenet of the cultural theory approach "is that human attitudes towards risk perception are not homogeneous but vary systematically according to cultural biases" (Royal Society, 1992, p.112). Until the cultural theorist approach was introduced, much of the focus in psychological studies had been on individual notions of perception. Douglas (1982) hypothesized that another dimension of risk perception to consider was the social context in which an individual functions.

> The reason for focusing upon the social context ... is that each pattern of rewards and punishments moulds the individual's behaviour. He will fail to make any sense of his surroundings unless he can find some principles to guide him to behave in the sanctioned ways and be used for judging others and justifying himself to others. This is a social-accounting approach to culture; it selects out of the total cultural field those beliefs and values which are derivable as justifications for action (Douglas, 1982, p.190).

One of the key factors in the determination of an individuals' social context is recognition of the social group(s) to which he or she belongs. Social relations in different cultural groups will influence an individual's attitudes and beliefs according to the cultural bias of the specific group. Cultural bias is referred to as the values and beliefs commonly shared by a group and influences the risks that the group chooses to identify in ways that cannot be justified by individual psychology or by the scientific analysis of objective risks (Royal Society, 1992). Different groups will have dissimilar standpoints on risk issues and will support different values and beliefs; as such, membership in different groups produces a diverse array of worldviews. Groups "differ in the degree of group cohesiveness (the extent to which someone finds identity in a social group), and the degree of grid (the extent to which someone accepts and respects a formal system of hierarchy and procedural rules)" (Rohrmann and Renn, 2000, p.34).

Due to the dynamics of social group involvement and the subsequent relationship between group and grid, researchers were able to identify four major groups in modern society that relate to risk analysis. The four common groups or patterns of social relations are: hierarchy, egalitarianism, individualism, and fatalism (Douglas and Wildavsky, 1982; Dake, 1991; Royal Society, 1992; Slovic, 1997). A fifth group is referenced in many literary sources but its precise designation tends to vary: technological enthusiasm (Slovic, 1997), autonomous individuals (Royal Society, 1992; Rohrmann and Renn, 2000), or hermit (Dake, 1991; Rohrmann and Renn, 2000).

"An individual's cultural bias is linked with the extent to which he or she is incorporated into bounded groups ('group') and with the extent to which the interactions of social life are conducted according to rules rather than negotiated *ad hoc* ('grid')"

(Royal Society, 1992, p.112). As such, each group has specific characteristics that provide insight into how its members will orient their worldviews. For instance, some of the pertinent characteristics for each group are:

a) Hierarchists – Prefer to have their societies structured with commands flowing down from authorities and obedience flowing up the hierarchy, e.g. decisions regarding health risks should be left to the experts (Slovic, 1997). Are willing to accept high levels of risk as long as decisions are made by experts or in other socially accepted ways (Royal Society, 1992).
b) Egalitarians – Prefer to have a world in which power and wealth are more evenly dispersed, e.g. if people were treated as equals, there would be fewer problems (Slovic, 1997). Like to emphasize the risks of technological development and economic growth so as to support their own way of life and attribute blame to those in other groups holding different cultural biases (Royal Society, 1992).
c) Individualists – Prefer to do their own thing, unrestricted by government or any other kinds of limitations, e.g. in a just system, people with greater ability should be able to earn more (Slovic, 1997). View risk and opportunity as interrelated factors, going hand-in-hand (Royal Society, 1992).
d) Fatalists – Are inclined to feel that what happens in life is inevitable and cannot be changed by an individual's actions, e.g. an individual will feel as thought they have very little control over risks to their health (Slovic, 1997). Tend to not knowingly take risks and tolerate what is in store for them (Royal Society, 1992).

The ensuing worldviews held by members of these groups "implies that people select certain risks for attention to defend their preferred lifestyles and as a forensic resource to place blame on other groups. [W]hat societies choose to call risky is largely determined by social and cultural factors, not nature" (Royal Society, 1992, p.112). According to Slovic (1997), a number of researchers have utilized survey techniques to measure worldviews and have found them to be correlated with public perceptions of risk. "Worldviews are general social, cultural, and political attitudes that appear to have an influence over people's judgments about complex issues" (Slovic, 1997, p.291).

Rohrmann and Renn (2000) provided a similar description of cultural theory with an updated classification of groups. The authors identified five groups within the group-grid scheme that are similar to those applied by previous scholars (see Figure 5). The

authors also noted that the five groups are broad classifications into which smaller social groups and organizations are categorized. The entrepreneurial group (similar to individualism) is characterized by a low degree of hierarchy and low degree of cohesion. Individuals belonging to this group perceive risk taking as an opportunity to succeed in a competitive market and to pursue their personal goals (Rohrmann and Renn, 2000). The egalitarian group (same as previous) emphasizes cooperation and equality as opposed to competition and freedom and is characterized by low hierarchy with a strong sense of group cohesiveness and solidarity. When faced with risk this group tends to focus on long-term effects of human activities and is more likely to abandon an activity than take chances, even if they perceive the activity to be beneficial (Rohrmann and Renn, 2000).

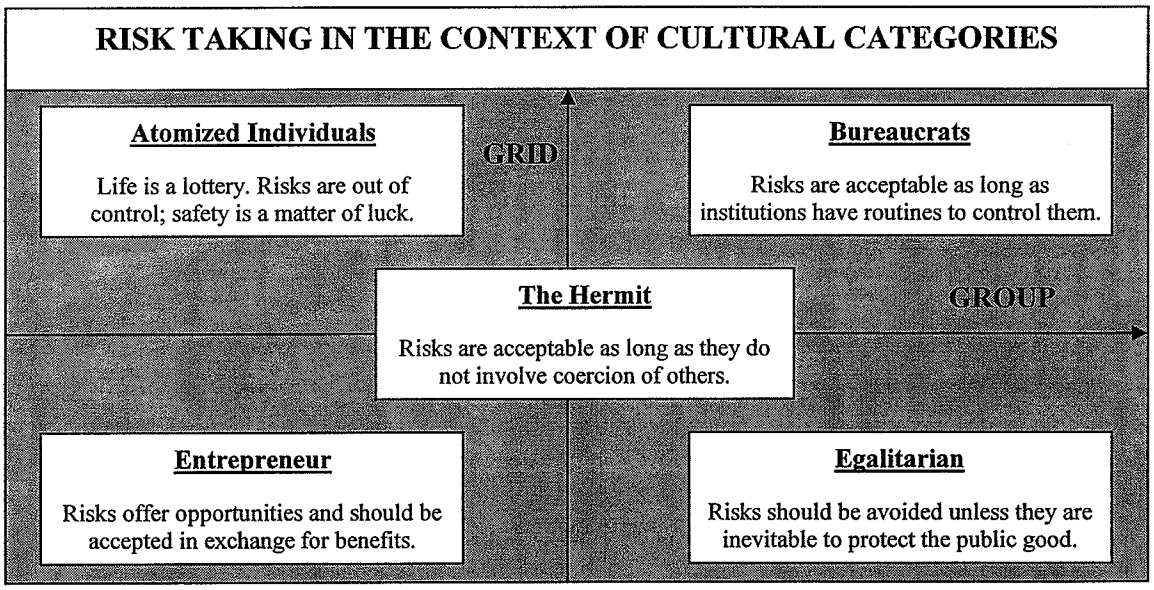


Figure 5: Group Types in Cultural Theory (Source: Adapted from Rohrmann and Renn, 2000, p.35)

The bureaucratic group (similar to hierarchy) relies on rules and procedures to cope with uncertainty and group relations are both hierarchical and cohesive. Members of this group do not worry about risks as long as capable institutions provide management and coping strategies for all members. Atomized or stratified individuals (similar to

fatalists) support hierarchy in principle, but do not identify with the hierarchy to which they belong. These individuals only place trust in themselves, are often perplexed by risk issues, and are likely to take high personal risks on their own merit, but oppose any risk that they feel is imposed upon them (Rohrmann and Renn, 2000). The final group, autonomous individuals or hermits, are self-centred and tend to be short-term risk evaluators. Members of this group could be viewed as potential mediators in risk conflicts, given that they build multiple alliances with the other four groups and support hierarchy only when they feel that authority has been gained due to superior performance or knowledge (Rohrmann and Renn, 2000).

Despite contributions to risk perception research, the group-grid approach and cultural theory have some drawbacks. "Although the theory is potentially powerful, there remains a basic problem in unambiguously classifying existing social units in terms of the grid and group dimensions [and] that the basic four or five cultural types may oversimplify more complex shades of social difference" (Royal Society, 1992, p.113). Rohrmann and Renn (2000) lamented that utilizing only five cultural patterns is too narrow and presumptuous because some behaviours will be compatible with more than one group classification. The authors also discredited the theory on the basis that researchers have not provided sufficient empirical evidence to support its validity.

In spite of the shortcomings, the cultural-theorist approach clearly identified some very important features of the social fabric at risk, contributed to an enhanced comprehension of risk perception and tolerance, and raised several critical issues for future research (Royal Society, 1992); "the emphasis on values and worldviews ... can be seen as the major accomplishment of this theory" (Rohrmann and Renn, 2000, p.36).

2.1.4 – The Social Amplification of Risk

The social amplification of risk (a metaphor loosely based on communications theory) is a conceptual framework developed by Kasperson et al. (1988) and intended to link the psychological, sociological, and cultural approaches to risk perception (Royal Society, 1992). The framework utilizes the notion that risk and hazard events "interact with psychological, social, institutional, and cultural processes in ways that can heighten or attenuate individual and social perceptions of risk and shape risk behavior. Behavioral patterns, in turn, generate secondary social or economic consequences that extend far beyond direct harms to human health or the environment" (Rohrmann and Renn, 2000, p.38). Kasperson et al. (1988) indicated that a primary purpose of the framework was to establish a comprehensive theory that could explain why low levels of risk or minor risk events (determined by technical experts) sometimes produce significant public reactions that result in considerable social and economic impacts and sometimes even increased physical risks. Conversely, the framework also set out to explain why the public downplays the importance of certain risks that are verified by experts to be quite serious.

The social amplification framework suggests that "most of our knowledge, and this includes our knowledge of hazards and danger, is second-hand; that is, we come to know about the world through various communications that we receive in the form of signs, signals, or images" (Royal Society, 1992, p.114). As such, the amplification process begins with the occurrence of a hazard event or recognition of a risk that produces a signal value (see section 2.1.2.5) to which both individuals and groups are receivers. Both parties identify specific characteristics or aspects of the event and

interpret them in accordance with their perceptions and mental schemata; signal values will vary amongst different people or social groups (Royal Society, 1992).

Interpretations are formulated into messages and subsequently communicated to other individuals and groups who then collect and respond to the risk information. These individuals and groups act as amplification stations through their subsequent behavioural responses and communications. Original interpretations are subject to predictable transformations as they pass through various social amplification stations; i.e. scientist groups, mass media, government agencies, politicians, community activist groups, and so forth. There is an intensification or attenuation of certain risk aspects by each station that is predictable in accordance with its social characteristics; these expected transformations serve as the rationale for differences in signal value reception (Royal Society, 1992; Rohrmann and Renn, 2000). "Amplification differs among individuals in their roles as private citizens and in their roles as employees or members of social groups and public institutions" (Rohrmann and Renn, 2000, p.38).

The social amplification framework also provides an explanation for the fact that the behavioural and communicative responses can cause a spreading of the impact, or rippling of secondary consequences, that may go well beyond the initial impact of the event and those directly affected. Individuals and social groups may also perceive the secondary consequences, resulting in further amplification to third-order consequences that may spread or ripple to other parties or locations (Royal Society, 1992; Rohrmann and Renn, 2000). "Each order of impact will not only disseminate social and political impacts but may also trigger (in risk amplification) or hinder (in risk attenuation) positive changes for risk reduction" (Rohrmann and Renn, 2000, p.38) (see figure 6).

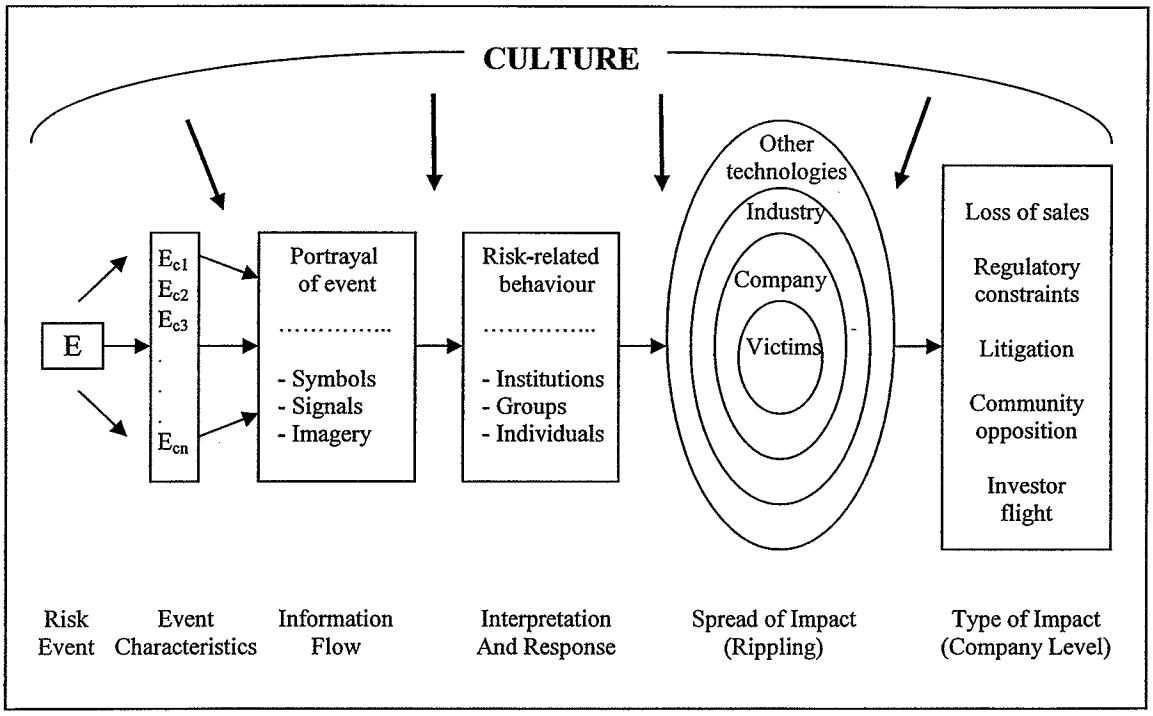


Figure 6: A Simplified Representation of the Social Amplification of Risk and its Potential Impacts
(Source: Adapted from Royal Society, 1992, p.115)

The Royal Society (1992) concluded that the original social amplification framework by Kasperson et al. (1988) was too narrow in scope because it only relied on a one-way communication process. Renn (1991) later acknowledged the pivotal role that feedback, from the receiver to the source, plays in the communication process and recommended that it be addressed in the social amplification framework.

> The social amplification framework provides an integrative concept. The distinction between individual and social amplification stations corresponds with the two traditions in risk perception: the individual processing of information and the social responses to risk based on experience of (dis)trust, social values, and cultural affiliations. It provides a more holistic picture of the risk perception process and takes into account psychological, sociological, and cultural aspects (Rohrmann and Renn, 2000, p.40).

2.1.5 – Risk Communication

The Royal Society (1992) summarized the work of numerous literary sources and identified four partially overlapping conceptual approaches to risk communication. The

first and most simple approach defines risk communication based on an engineering type framework. The top-down or command-and-control approach acts as a one-way transmission of a risk or hazards message from an expert to a targeted non-expert audience. As noted earlier, there are many drawbacks and criticisms of this approach, "in particular on the grounds that by assuming an altruistic communicator it implicitly devalues the perspectives and knowledge of the risk bearers, as well as glossing over the political aspects to many of the risk conflicts in society" (Royal Society, 1992, p.120).

The second approach involves a two-way interactive exchange of information between individuals, groups, and institutions that goes beyond dealing only with the specific risk problem to address any pertinent concerns, opinions, and reactions. This approach is more effective because it allows for learning on all sides of a risk debate or conflict situation (Royal Society, 1992). The third approach builds on the two-way information exchange and learning approach by including the broader cultural and institutional contexts that determine the characteristics of specific risk issues. The benefit of this approach is that it puts the onus on the risk communicator to fully understand the context within which risks and communications occur. The final approach involves risk communication being viewed as an element of the wider political processes in democratic society. "Communication is seen as an essential prerequisite to the enabling and empowerment of the risk-bearing groups in society in ways that allow them to participate more effectively in decision making about risks" (Royal Society, 1992, p.121).

There are a number of other hindrances to effective risk communication. "Doing an adequate job of communicating means finding comprehensible ways of presenting complex technical material that is clouded by uncertainty, and is inherently difficult to

understand" (Slovic, 1986, p.403). According to Slovic (1986), communicators must be aware of the characteristics of public attitudes and perceptions towards risk because:

a) people's perceptions of risk are often erroneous due to factors such as the memorability of past events and the imaginability of future events;
b) risk information may alarm and aggravate the public;
c) strong beliefs are often difficult to change; and
d) naïve views are easily influenced by presentation format and as such, slight changes in the way that risks are articulated can have a major impact on people's perceptions and decisions.

Making an effort to comprehend the way in which the public perceives and responds to risk will aid the development of effective risk communication methods (Gough, 1998).

Another difficulty inherent to risk communication is that risk and emergency management representatives "have often tried to communicate with the public under the assumption that they and the public share a common conceptual and cultural heritage in the domain of risk. That assumption is false and has led to failures of communication and rancorous conflicts" (Slovic, 1986, p.407/08). Slovic (1986) exemplifies this point with an analogy: a stranger does not visit a foreign country for the first time and expect to communicate effectively without having any prior knowledge of the country's language or culture. Thus to communicate effectively, emergency managers must have an awareness and understanding of the cultural context in which they are making decisions.

A critical consideration for risk communicators is the notion of framing effects or how questions and issues regarding risk are administered. "The content of any message must be sensitive to the receiver's frame of reference for the problem ... there are many publics within any society each with possibly different worldviews and frameworks for approaching risk problems" (Royal Society, 1992, p.121). Risk communications must be sensitive to the intended audience or they may be ignored, misinterpreted, or criticized.

> [Laypeople] appear to use only the information that is explicitly displayed in the formulation of the problem. Information that has to be inferred ... or created by some mental transformation tends to be ignored. The tendency for considerations that are out of sight to be out of mind ... imposes a serious burden on those entrusted with [the] presentation of risk information (Slovic et al., 1982a, p.24).

Therefore, risk communicators must ensure that risk messages are clear and explicitly state all of the intended points. Receivers are unlikely to infer or 'read between the lines' of an ambiguous message and as such, valuable information may not be considered.

> Doing an adequate job means finding cogent ways of presenting complex, technical material that is clouded by uncertainty and subject to distortion by the listener's preconceptions – or misconceptions – about the hazard and its consequences. Moreover ... people are often at the mercy of the way in which problems are formulated. Those responsible for determining the content and format of information programs thus have considerable ability to manipulate perceptions (Slovic et al., 1982a, p.35).

2.1.5.1 – Trust and Confidence in Institutions

The "most powerful factor for predicting risk perceptions is trust in institutions or ideology, which is largely about which institutions can be trusted" (Wildavsky and Dake, 1990, p.56). As such, public confidence and trust in the institutions and authorities responsible for risk management play a pivotal role in perceptions of risk and subsequent behavioural responses. This point is summarized by Rohrmann and Renn (2000):

> Among the most influential social factors in shaping risk perception and responses social networks and reference group judgments are particularly influential since most information about risk is not learned through personal experience but through "second-hand" learning. With the advent of ever more complex technologies and the progression of scientific methods ... personal experience of risk has been more and more replaced by information about risks and individual control over risk by institutional risk management. As a consequence, people rely more than ever on the credibility and sincerity of those from whom they receive information about risk. Thus, trust in institutional performance has been a major key for risk responses (p.31).

Accordingly, the Royal Society (1992) recognized that the issue of trust in institutions responsible for risk management is one of the fundamental links between risk

perception and risk communication. The adage 'trust is hard to gain, but easy to lose' has finite importance as the level of trust placed in a risk communicator by a receiver is crucial to the communicator's credibility; if the receiver does not trust the message source then they are less likely to trust the message and its content (Royal Society, 1992).

"Trust may be lost following a serious incident or actual disaster, if the responsible authorities and institutions are not felt to be learning from, and responding to the event in as open and public a way as is possible" (Royal Society, 1992, p.122/3). The 1997 flood in the Red River Basin illustrated such a case, where emergency management conducted in a top-down manner resulted in a loss of institutional trust as elements of misunderstanding and discontent arose due to misinformation and poor communication (Haque, 2000). When decision makers choose to ignore strong public opinions, resultant decisions can cause feelings of hostility, mistrust, and alienation (Fischhoff et al., 1983). With a loss in trust or credibility the likelihood for difficulties in future communication efforts is significantly increased; "the more individuals believe that risks are not properly handled (in addition to being perceived as serious threats) the higher the likelihood that people will be politically active" (Rohrmann and Renn, 2000, p.32).

A potential solution to avoid trust eroding communication practices is to move away from the top-down communication approach. "Early, on-going, open and honest interaction is a prerequisite to effective, as well as ethical risk communications" (Royal Society, 1992, p.123). Utilizing a risk communication approach that is more in line with the latter three conceptual approaches described the Royal Society (see prior discussion in section 2.1.5) is more likely to build and retain trust and consequently, be more sustainable in the event of a disaster. Effective communication needs to be a two-way

process that establishes common ground and trust in relationships between all interested parties because without the establishment of trust, it is unlikely that amicable policy solutions can be achieved (Gough, 1998).

> [T]here is wisdom as well as error in public attitudes and perceptions. Lay people sometimes lack certain information about hazards. However, their basic conceptualization of risk is much richer than that of the experts and reflects legitimate concerns that are typically omitted from expert risk assessments. As a result, risk communication and risk management efforts are destined to fail unless they are structured as a two-way process. Each side, expert and public, has something valid to contribute. Each side must respect the insights and intelligence of the other (Slovic, 1987, p.285).

2.2 – Summary

This chapter established the nature of perceived risk at the individual level (pioneered by research in psychology and geography) and the associated societal or cultural context (pioneered by research in sociology and anthropology). As noted by Cutter (1993) the cultural selection of threat is not linked to objective risk measurements or the physical reality of risk, rather the selection of threat reflects positions that are all value-laden and culturally constructed. As such, there is a noticeable divergence between experts' and laypersons' perceptions of risk. One of the contributing factors in the deviation is the existence of a management structure focused primarily on technical solutions to hazard related problems – the dominant view. "The lesson to be learned is that technological solutions are likely to be inadequate without knowledge of how they affect the decision-making of individuals at risk" (Slovic et al., 1976, p.166).

Part of the solution to effective hazard and disaster management is awareness of the dynamics of risk perception. When laypeople evaluate risk they seldom use statistical evidence, rather they rely on inferences based on what they hear or observe about the threat. The general inferential rules people use in uncertain situations are referred to as

judgmental rules or heuristics. Laypeople use these rules to reduce difficult mental tasks into simpler, more manageable tasks. The four main heuristics identified in the literature are: the availability heuristic, representativeness heuristic, anchoring and adjustment heuristic, and affect heuristic. The problem herein is that these heuristics are subject to notable biases when they are used to make sense out of uncertain situations.

Researchers postulated that studies in risk perception needed to extend beyond the psychometric approach and account for the social fabric at risk. It was determined that social, cultural, and institutional processes are integral to the appreciation of risk perception and related behaviour. Cultural theorists proposed that individuals in society fall into different groups (hierarchists, egalitarians, individualists, and fatalists) with each having their own cultural bias, or sets of values and beliefs, as well as variant worldviews that influence individual perceptions. The social amplification of risk was developed as a conceptual framework intended to merge psychological, sociological, and cultural perspectives on perception. This framework suggested that certain aspects of risk are intensified or attenuated as they pass through processes of interpretation and response.

Risk perception and risk communication are inherently linked as the manner in which risk is communicated can have profound influences on subsequent risk-related decision-making and behaviour; effective communication involves a two-way process between individuals and authorities. A fundamental component of risk communication is trust and confidence in institutions. If the receiver does not trust and have confidence in the communicator, the effectiveness of the message will be significantly reduced.

CHAPTER 3
RESEARCH DESIGN AND METHODS

3.1 – The Delphi Technique: A Review

3.1.1 – Introduction

"Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (Linstone and Turoff, 1975, p.3). The conventional Delphi was originally utilized in military studies by the RAND Corporation as a forecasting tool intended to elicit subjective judgments from a group of experts and to achieve consensus on desired issues. As the technique progressed into popular use in the private and public sectors variations developed. For example, the Policy Delphi uses all relevant stakeholders, not just experts, and strives to elicit divergent views or dissensus.

The Delphi technique is a qualitative tool and its integral purpose is to eliminate confrontation and other problems associated with committee-based group decision-making processes. The Delphi technique is useful "when accurate information is unavailable or expensive to obtain, or evaluation models require subjective inputs to the point where they have become the dominating parameters" (Linstone and Turoff, 1975, p.10). There are three distinguishing features of Delphi: i) *anonymity,* ii) *iteration,* and iii) *controlled feedback.* These features are vital to the importance of the Delphi technique as a strategy for idea generation.

3.1.2 – History and Evolution

The evolution of the Delphi technique has spanned several decades and based on a framework developed by Rieger (1986) can be described as a progression through five

eras: secrecy, novelty, popularity, scrutiny, and continuity and refinement. The origins and earliest workings of the Delphi technique can be traced back to the late 1940s and early 1950s in research conducted by Olaf Helmer, Norman Dalkey, and their colleagues at the RAND Corporation (Rieger, 1986). The RAND Corporation was developed as a project for research and development under the auspices of the United States Air Force and the Delphi concept resulted as a spin-off of its defence research (Linstone and Turoff, 1975). The *era of secrecy* ran from these initial stages of development into the early 1960s, when the technique was primarily used as a military application for the projection of potential outcomes from future nuclear warfare (Rieger, 1986). The technique was used as a systematic means for combining expert judgments in "determining the optimal number of targets and A-bombs which would reduce the United States' munitions output to a certain level" (Needham and de Loe, 1990, p.135).

The *era of novelty* began in the mid-1960s after the U.S. military declassified the technique and corporate planners in the U.S. recognized its benefits for forecasting in industrial and human service organizations (Rieger, 1986). Usage in the U.S. led to applications of the technique in Western Europe and the novelty of Delphi spread further into Eastern Europe and parts of Asia by the late 1960s (Rieger, 1986).

The spread of Delphi usage across continents led to the *era of popularity* that started in the late 1960s and lasted well into the mid-1970s (Needham and de Loe, 1990). In fact, Linstone and Turoff (1975) noted that in the period prior to 1970, 134 articles, papers, and materials utilizing the Delphi technique had been produced and between 1970 and 1974 another 355 were published as Delphi popularity peaked.

The *era of scrutiny* began with the 1974 release of Harold Sackman's report entitled 'Delphi Assessment: Expert Opinion, Forecasting, and Group Process' (Rieger, 1986). The report was intended to be a critical analysis of the Delphi technique for the RAND Corporation and condemned the scientific respectability of the technique based on numerous sloppy executions (Sackman, 1974). This report was met with harsh criticism from Delphi proponents; advocates of the technique perceived the report to be an attack on the Delphi, rather than a critical analysis of its performance. As such, nearly an entire issue of the journal *Technological Forecasting and Social Change* was devoted to articles that defended Delphi and discredited the Sackman report (Rieger, 1986). Coates (1975), Goldschmidt (1975), Linstone and Turoff (1975), and Scheele (1975) countered the criticisms, citing that many Delphi studies had been poorly executed and the technique was often misused; as such, it was not the technique itself that should be criticized, rather it was the users and their specific application of the technique that should be.

After the controversy during the era of scrutiny subsided, the *era of continuity and refinement* transcended during the 1980s; between 1980 and 1984 another 130 items were published on the Delphi technique and 441 Delphi related doctoral dissertations were completed (Rieger, 1986). The Delphi technique moved into a period where it was accepted as a legitimate methodology and effort was spent refining specific aspects of the technique rather than defending its validity (Needham and de Loe, 1990). Advancement of the technique occurred with the completion of studies in areas such as group stability, the accuracy of predictions, the effect of iteration on the accuracy of long-range predictions, and the response behaviour of individuals (Needham and de Loe, 1990).

One element in the evolution of the Delphi that Rieger's framework did not address was the development of variations in the technique. One of Delphi's strengths as a methodological tool is that it allows users to modify the technique so that it will best serve their purposes. Turoff (1970) introduced the Policy Delphi as an alternative to the conventional Delphi for the solicitation of opinions on problems related to policy issues. Alternatives to the conventional Delphi are considered in section 3.1.7.

3.1.3 – The Design of a Delphi Process

As noted earlier, the Delphi technique is a method that is intended to structure the group communication process for the purposes of problem resolution. As such, a Delphi study can be classified as an Idea Generating Strategy (IGS); an IGS is designed for issue and problem identification or for the genesis of new information about specific problems and issues (Needham and de Loe, 1990). There are two IGS process types (see Figure 7).

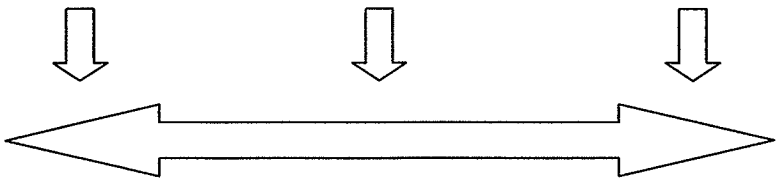
Non-Group Processes	A public opinion poll with neither iteration nor feedback An individual thinking alone A discrete perception and attitude survey A referendum
Group Processes	Brainstorming Sessions and Workshops — Nominal Group Techniques — Delphi  High — Interaction Continuum — Low

Figure 7: The Two IGS Process Types (Source: Adapted from Needham and de Loe, 1990, p.135)

Non-group processes are classified as discrete and can be represented by individual thinking or an expert group survey; the key characteristic of this type of process is a lack of iteration and feedback during the implementation phase (Needham and de Loe, 1990). Alternatively, group processes involve thinking and interaction, the degree of which varies depending upon the type of group process employed (Needham and de Loe, 1990). For instance, as indicated by the interaction continuum in Figure 7, a brainstorming session has a high level of interaction as group members come face-to-face for idea generation and re-evaluative discussion; whereas a Delphi has a low level of interaction as group members generate ideas on their own and make revisions based on feedback distributed in written form (Needham and de Loe, 1990).

Rather than bringing individuals together, the Delphi process commonly relies on the utilization of written responses from group members for the purposes of aggregating a number of individual judgments to be used in the facilitation of decision-making (Delbecq et al., 1975). It is vital to note that the Delphi technique *is not* a decision-making tool; rather it is a tool that can be *used to aid* decision-making. Written responses are generated through a series of questionnaires administered through the mail, thus allowing respondents to remain anonymous. An initial questionnaire is distributed requesting that individuals respond to a broad question statement. Subsequent questionnaires build upon responses to the preceding questionnaires and are continued until consensus has been reached among the respondents or until sufficient information exchange has occurred (Delbecq at al, 1975). Delbecq et al. (1975) explicitly stated that there are three critical conditions necessary for the successful completion of a Delphi:

i. adequate time – the minimal amount of time required is about 45 days;

ii. respondent skill in written communication – groups that have difficulty in reading or written communication should be avoided; and
iii. high respondent motivation – interest and commitment are required from the respondents because there are no moderators present to stimulate and maintain motivation.

In addition, Delbecq et al. (1975) stated that there are generally three different groups involved in the Delphi process:

i. the decision makers who will utilize the outcomes of the Delphi;
ii. the research or monitor team; and
iii. the respondents to the Delphi, whose judgments and opinions are being sought.

The research or monitor team must design, administer, and analyze the questionnaires, assess the utility of information generated, and complete questionnaire revisions in the event that they are ineffective (Delbecq et al., 1975). It is also important to ensure that one team member is knowledgeable about conducting a Delphi and has a good awareness of the issue being studied (Delbecq et al., 1975). Often, Delphi studies are for academic purposes rather than institutional purposes and as such, the groups involved in the process are simply the respondents and the research team. For example, Bardecki (1984) used a research team of three to four persons as the work group who administered the Delphi survey. In other cases an institution may employ in-house staff or private consultants with Delphi experience to conduct the study (Richey et al., 1985).

Linstone and Turoff (1975) described the Delphi process as a progression through four distinct phases.

> The first phase is characterized by exploration of the subject under discussion, wherein each individual contributes additional information he feels is pertinent to the issue. The second phase involves the process of reaching an understanding of how the group views the issue (i.e. where the members agree or disagree and what they mean by relative terms such as importance, desirability, or feasibility). If there is significant disagreement, then that disagreement is explored in the third phase to bring out the underlying reasons for the differences and possibly to evaluate them. The last phase, a final evaluation, occurs when all previously

> gathered information has been initially analyzed and the evaluations have been fed back for consideration (p.6).

Bardecki (2002) described the Delphi process in terms of a three-round survey. The first round is exploratory, where idea generation is the primary goal. The second round is intended to be an opportunity for respondents to justify the positions that they took in the first round. The third round provides respondents with the opportunity to observe the counter arguments that other respondents made against their individual positions. Any subsequent rounds are dependent upon the needs of the research team, the original goals of the study, and the adequacy of the data collected.

Additionally, Delbecq et al. (1975) identified a means for designing and administering a Delphi in a more detailed, step-by-step framework. It is important to note that each step will not be replicated in every Delphi study; as mentioned earlier, the flexibility of the technique allows for steps to be adjusted based on modifications to the Delphi format being applied. The key steps in this framework are noted in Appendix 1.

3.1.4 – Strengths

The primary strength of the Delphi technique lies in its advantage as an anonymous group process for the generation of ideas. "Group processes have been shown to be superior to non-group process in terms of [the] average number of unique ideas produced, average total number of ideas produced, and quality of ideas produced" (Needham and de Loe, 1990, p.134). One of the main benefits of the Delphi technique is that it does not require face-to-face contact of the respondents because it is primarily a mail-out survey. Another advantage is that multi-phased Delphi processes tend to have a low cost for application (Sackman, 1974; Delbecq et al., 1975; Richey et al., 1985). In

comparison with face-to-face interviews, Van Dijk (1990) cited mail-out surveys as the cheapest and most time efficient method for generating more concise answers.

The element of anonymity associated with the Delphi technique acts to minimize the psychological effects that often disrupt face-to-face meetings. "In interacting group situations, creativity (and thus the quality and quantity of ideas produced) is inhibited by factors such as interpersonal stress caused by dominance of one or more members, or by some people's lack of oral communication skills" (Needham and de Loe, 1990, p.134/35). Without face-to-face meetings there is no domination of the discussion by a singular vocal, outspoken individual who may suppress the opinions of more shy respondents (Delbecq et al., 1975). "Delphi can also be used to aggregate judgments where people are hostile toward one another, or where individual personality styles would be distracting in a face-to-face setting" (Delbecq et al., 1975, p.83).

One of the important practical and procedural advantages of Delphi studies that results from the lack of face-to-face contact is "being able to get opinions from a broader group of people than could be assembled in a single place without great difficulty" (Scheele, 1975, p.218). Potential respondents with very busy schedules may not be able to commit the time to travel long distances and spend numerous days in workshop type settings. As such, use of Delphi is advantageous because it allows respondents to answer the questionnaire in their place of choice and at their leisure. "Those who favored the mailed questionnaire mainly mentioned the possibility of thinking longer and more deeply about the answer and of reading the question(naire) more than once" (Van Dijk, 1990, p.297). It is important that a return date be specified that allows adequate response time for the respondents and still meets the requirements of the study timelines.

For conventional Delphi applications intended to move a group towards consensus on an issue, the iterative format provides beneficial assistance in reaching this goal. Studies have shown that successive rounds of Delphi administration can reduce the spread between the upper and lower quartile values for a given question and as such create more convergence or consensus on an issue (Jones, 1975). A study by Scheibe et al. (1975) concluded that, "most respondents are both interested in the opinions of the other members of the group and desirous of moving closer to the perceived consensus" (p.272). The iterative format has also proven beneficial in instances where the Delphi is not aimed at generating consensus. "The iterative nature of the Delphi technique allows for a formal exploration of areas of disagreement and an evaluation of the underlying reasons for these disagreements" (Richey et al., 1985, p.137). The ability to explore minority or dissenting views is seen as one of the integral strengths of the Delphi process.

For other non-conventional applications of the Delphi technique aimed at collecting divergent views on an issue, one advantage of having the research team condense respondent comments into shorter summaries is that it makes successive questionnaires shorter and more succinct (Delbecq et al., 1975). When subsequent questionnaires are more concise and require less time for the respondents to complete, the likelihood of a higher response rate is increased.

3.1.5 – Weaknesses

One of the most challenging obstacles to overcome in many Delphi applications has been panellist dropout; "panelist dropout is one of the well-known hazards of Delphi experimentation. Delphi dropout rates are ... quite high" (Sackman, 1974, p.20). For instance, in a study by Richey et al. (1985) 72 panellists were selected to participate in a

two-round survey, after the first round 10 panellists dropped out and of the 62 remaining only 36 participated in the second round. A study by de Loe (1995) sent out 189 first round questionnaires and had only 48 returned (a response rate of approximately 25%); the second round of the survey yielded only 27 fully complete surveys and another 8 that were partially complete. A two-round survey by de Loe and Wojtanowski (2001) sent out 367 surveys and had only 50 returned in the first round (a response rate of 15%); of those 50 surveys only another 36 were returned in the second round. "The quality of responses is very much influenced by the interest and commitment of the participants. Delphi requires especially high participant motivation since other people are not present to stimulate and maintain motivation" (Delbecq et al., 1975, p.85).

As mentioned previously, while much of Sackman's (1974) critical review of the Delphi technique was refuted and discredited, Goldschmidt (1975) noted that there were some valid arguments regarding limitations of the technique. Goldschmidt (1975) validated Sackman's observation that often times Delphi users do not construct their questionnaires with sufficient consideration. Goldschmidt (1975) stated that, "many, if not most, Delphi questionnaires are not pretested [and] questions are often ambiguous" (p.198). Fortunately, many Delphi studies conducted after Sackman's review (see Richey et al., 1985) made note of the shortcoming and involved some type of pretesting method to ensure the accuracy and validity of questionnaire content.

Sackman (1974) further criticized the technique by stating that "Delphi reports characteristically offer little or no information about panellist selection, and provide no safeguards against such abuses" (p.33). Again, at the time of Sackman's review this may have been a valid criticism, but many studies that utilized the Delphi technique after the

review clearly identified the methods in which panellists were selected (see Richey et al., 1985; Needham and de Loe, 1990; de Loe, 1995). Delphi practitioners have put more effort into "delineating and explicating the philosophic and methodological parameters of each Delphi inquiry" (Scheele, 1975, p.217).

Another limitation is that the Delphi process tends to "minimize the feelings and information normally communicated in such manners as the tone of voice, the gesture of a hand, or the look of an eye. In many instances these are a vital and highly informative part of a communication process" (Linstone and Turoff, 1975, p.7). Traditional group processes allow the researcher to observe and record the emotions associated with certain responses or verbal exchanges. The anonymous nature of the Delphi process precludes this potentially pivotal subjective component of studies from being included.

While creating summaries of group comments may have its advantages, there is also an inherent disadvantage to having the research team creating summaries of respondent answers. The research team may misinterpret or neglect a respondent's comments or even unknowingly introduce their own bias into the summary (Delbecq et al., 1975). Linstone and Turoff (1975) stated that misunderstandings may arise when respondents are from diverse cultural backgrounds and have different characteristics regarding language and logic.

3.1.6 – Applications and Uses

After its origins as a predictive tool within a non-profit organization, the Delphi technique broadened into a multiple-use planning tool that found its way into usage by government, industry, and academia (Linstone and Turoff, 1975; Delbecq et al., 1975).

Linstone and Turoff (1975) compiled a listing of Delphi uses, prior to 1975, which did not involve technological forecasting. The list included the following:

a) Gathering current and historical data not accurately known or available.
b) Examining the significance of historical events.
c) Evaluating possible budget allocations.
d) Exploring urban and regional planning options.
e) Planning university campus and curriculum development.
f) Putting together the structure of a model.
g) Delineating the pros and cons associated with potential policy options.
h) Developing causal relationships in complex economic or social phenomena.
i) Distinguishing and clarifying real and perceived human motivations.
j) Exposing priorities of personal values, social goals (p.4).

The list of fields that have employed the Delphi technique is expansive, crossing many disciplines including: public health, administration, and policy; education planning; environmental assessment and management; urban planning; medicine; corporate management; and others (Needham and de Loe, 1990). Many academics have utilized the Delphi technique in a wide range of research areas including: Bardecki (1984) in the study of wetland conservation policies; de Loe (1995) in the study of water management policy issues; and Richey et al. (1985) in the study of environmental assessment.

Linstone and Turoff (1975) stated that it is not the particular nature of an application that determines its suitability for using the Delphi technique; rather, it is the specific circumstances that are attributable to the associated group process. Linstone and Turoff (1975) provided a listing of potential properties related to group processes that an application suitable for study with a Delphi may include:

a) The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis.
b) The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise.
c) More individuals are needed than can effectively interact face-to-face.
d) Time and cost make frequent group meetings infeasible.

e) The efficiency of face-to-face meetings can be increased by a supplemental group communication process.
f) Disagreements among individuals are so severe or politically unpalatable that the communication process must be referred and/or anonymity assured.
g) The heterogeneity of the participants must be preserved to assure validity of the results, i.e. avoidance of domination by quantity or strength of personality (p.4).

3.1.7 – Variants: The Policy Delphi

After declassification, use of Delphi by academics resulted in the creation of slightly modified versions of the conventional technique developed by Helmer and Dalkey at the RAND Corporation. Variants were established with the same underlying principles of the conventional Delphi (*anonymity*, *iteration*, and *controlled feedback*), but utilized a modified process and often produced different outcomes. For instance, the Real-Time Delphi or Delphi Conference, originally outlined by Turoff (1970), involved the use of computer programs to compile and analyze group responses. The Policy Delphi, also initiated by Turoff (1970), was a means for using Delphi to answer a policy question or deal with a policy issue. The key aspect of the variants was that they were not developed during the era of continuity and refinement; they emerged during the eras of novelty and popularity alongside the conventional Delphi. One of the basic features of the Delphi technique is that it is an old methodology; it has been applied for the past fifty years without undergoing any rigorous methodological advancement (Bardecki, 2002).

For the purposes of hazard and disaster management, the Policy Delphi appears to be quite applicable because "a policy question is one for which there are no experts, only advocates and referees" (Turoff, 1970, p.151). Conventional Delphi studies have focused on soliciting judgments from experts, who are commonly defined as people that possess expertise or specialized training. "Unfortunately, this [definition] excludes individuals who derive expertise, not from specialized training, but from real or first-hand

experience, or familiarity" (Needham and de Loe, 1990, p.136). Needham and de Loe (1990) proposed that an expert could be identified based upon an individual's closeness to a problem or experience with an issue. "Within the experts' population, some individuals have degrees of subjective or objective closeness because of their profession and occupation, training or education, regional experience or residency, and other explanatory variables" (Needham and de Loe, 1990, p.136). The various types of experts can be delineated on a closeness continuum (see figure 8).

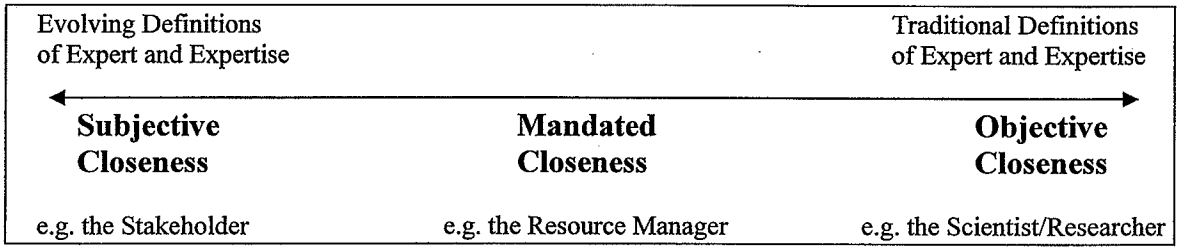


Figure 8: The Closeness Continuum (Source: Adapted from Needham and de Loe, 1990, p.138)

As such, the Policy Delphi is not intended to solicit judgments solely from traditionally defined experts; rather, it is a means to gather the opinions of anyone with pertinent experience. It is necessary in "a Policy Delphi that informed people representative of the many sides of the issues under examination are chosen as participants" (Turoff, 1975, p.88). By involving all of the experts on an issue, individuals with subjective, mandated, and objective closeness can all contribute evidence that is vital to understanding an issue; the same merit is placed in a participant regardless of where they fall on the continuum. A Policy Delphi can be succinctly defined as: "a multi-round survey that permits a diverse group of people, selected for their expertise, to interact anonymously on a defined topic" (de Loe and Wojtanowski, 2001, p.3).

A crucial element that distinguishes a Policy Delphi from a conventional Delphi is the outcome; consensus is not necessarily the ultimate goal in the former, as dissensus is

equally acceptable. "A Policy Delphi deals largely with statements, arguments, comments, and discussion ... and seeks to generate the strongest possible opposing views on the potential resolutions of a major policy issue" (Turoff, 1975, p.84/89). Essentially, the Policy Delphi is intended to elicit both pro and con arguments; some respondents may agree and achieve consensus on a given issue, while others may disagree and appear as outliers presenting opposing views (Turoff, 1975). The key is to ensure that respondents support their positions with detailed reasoning, because it is within this commentary that much of the imperative data on an issue will be found; "the strength of evidence provided in support of positions can be determined, and the bases for agreement or disagreement within the group can be identified" (de Loe and Wojtanowski, 2001, p.7).

Turoff (1970; 1975) intended for the Policy Delphi to be a flexible method and focused on describing principles and guidelines of the technique, rather than outlining rigid procedures to follow. A study by de Loe (1991) verified this characteristic in a review of Policy Delphi applications; the author frequently observed that Policy Delphi users customized and adapted the Delphi process to meet the needs of their specific study. Turoff (1975) noted that the Policy Delphi was not intended to be a decision-making tool that would replace the committee process; rather, he anticipated that the Policy Delphi would serve as a precursory decision facilitation process, involving 10 to 50 people, which would be followed by a small committee meeting in which the results would be utilized to formulate policy. Turoff (1975) recommended that six phases should be present in the communication process when designing a Policy Delphi:

i. *Formulation of the issues.* What is the issue that really should be under consideration? How should it be stated?
ii. *Exposing the options.* Given the issue, what are the policy options available?

iii. *Determining initial positions on the issues.* Which are the ones everyone already agrees upon and which are the unimportant ones to be discarded? Which are the ones exhibiting disagreement among the respondents?
iv. *Exploring and obtaining the reasons for disagreements.* What underlying assumptions, views, or facts are being used by the individuals to support their respective positions?
v. *Evaluating the underlying reasons.* How does the group view the separate arguments used to defend various positions and how do they compare to one another on a relative basis?
vi. *Re-evaluating the options.* Re-evaluation is based upon the views of the underlying "evidence" and the assessment of its relevance to each position taken (p.87/88, italics added).

Turoff (1975) noted that these six phases require a five round Delphi survey, but could be accomplished adequately in three or four rounds if the design team carefully pre-formulates the obvious issues, seeds the list with an initial range of options which could be added to by respondents, and asks for positions on an item and underlying assumptions in the first round. In subsequent studies, de Loe (1991; 1995) integrated all of these phases and reduced the Policy Delphi into a two-round survey.

3.1.8 – Summary

The Delphi technique is classified as an idea generating strategy and is intended to identify issues of concern or to generate new information on existing problems. A Delphi process typically involves a research team obtaining subjective judgments and opinions through a group process. A key feature of the Delphi process is that group opinions are solicited through mail-out surveys that do not require face-to-face contact of the respondents. A Delphi process is iterative and commonly broken down into two or three rounds with controlled feedback: the first round focuses on issue identification and exploration, the second round on the recognition of convergent and divergent views on the issues, and the third round on exploration of reasons for convergence or divergence.

One of the advantages of the Delphi technique is its flexibility, as there is no rigid process to follow and the technique can be formulated to fit specific applications. Another key strength of the technique as a group process is that *anonymity*, *iteration*, and *controlled feedback* allow all participants to make meaningful contributions. The hostility and dominance that often sidetracks and inhibits productive idea generation in face-to-face group meetings does not occur in Delphi studies.

There are also inherent weaknesses and limitations associated with the technique that potential users must be aware of before implementation. Due to the significant time requirements of a Delphi study, dropout rates tend to be quite high and can undermine project objectives. Also, the lack of personal communication can potentially be a source for lost information. However, Linstone and Turoff (1975) suggested that "in any one application it is impossible to eliminate all problems associated with Delphi. It is the task of the Delphi designer to minimize these problems as much as possible ... within the context of the objective of the particular Delphi and the nature of the participants" (p.7).

Policy Delphi utilize the same features as conventional Delphi (anonymity, iteration, and controlled feedback), but differ with respect to the final outcome or goal of the process by generating dissensus as well as consensus. Policy Delphi attempt to gather both pro and con perspectives related to a specific policy issue, rather than trying to sway the group towards consensus. There are six phases essential to the design of a Policy Delphi process: formulating the issues, exposing the options, determining initial positions on the issues, exploring and obtaining the reasons for agreement or disagreement, evaluating the underlying reasons, and re-evaluating the options (Turoff, 1975).

3.2 – Research Design and Methods

3.2.1 – Introduction

The primary goal of this research is to examine flood risk perception and its role in decision-making in relation to hazard and disaster management in the Red River Basin. The principal social science research method utilized for this research study was a modified version of the Policy Delphi utilized by de Loe and Wojtanowski (2001). A unique strength of this modified Delphi Process was that the participants selected were not comprised solely of individuals whose expertise was derived from job-related training; rather, the group included individuals whose expertise on the issues came from personal experience fighting past flood events. The main reason for employing a Delphi process was for its ability to identify and clarify pertinent policy-related issues.

There are few techniques available to study subjective judgments or to assess people's intuitions and estimations of future events based on their past experiences and knowledge. The Delphi technique is especially useful in situations where specificity is lacking, i.e. there are elements of uncertainty requiring subjective judgments from respondents that a more scientific instrument may not be able to adequately obtain. "Even in the area of 'classical' management science and operations research there is a ... need to incorporate subjective information directly into evaluation models dealing with the more complex problems facing society" (Linstone and Turoff, 1975, p.11). The strength of the Delphi process as a tool for resource managers lies in its ability to uncover uncertainty and divergent views (Linstone, 1975).

Laypeople are expected by institutions to respond to disasters in a rational manner, yet as indicated in the literature there are a number of factors inherent to decision-making under uncertainty that influence behaviour and create unexpected

responses. The Delphi technique provides the best ability to examine future perspectives and issues (e.g. how people perceive the threat from future flood events). The technique is beneficial in that: i) it is *flexible* and *adaptable* for the user, ii) it involves *anonymity* and as such, allows for the determination of consensus or dissensus on an issue without having one respondent influence the views of another, and iii) the *iterative* and *controlled feedback* mechanisms act to refine data, sharpen awareness, and increase content validity.

3.2.2 – Identification of Sampling Frame and Study Area

The sampling frame and study area for the research were developed in accordance with roundtable discussions held at the ***Workshop on the Application of the Delphi Technique to Sustainable Floodplain Management***, August 28-29, 2002 at the Natural Resources Institute, University of Manitoba. The primary region and scope of the study was limited to the Manitoba part of the Red River Basin. The study involved a total of 42 participants divided into two groups based on association. Group A was comprised of 30 Flood Area Residents and Group B was comprised of 12 Institutional Representatives. It is worth citing Turoff (1970; 1975), who indicated that to ensure significant generation of unique ideas a desired response rate for a Delphi study ranges from 10 to 50 respondents. Turoff reasoned that in Delphi studies, sample sizes of more than 50 respondents tend to produce repetitious ideas and the distinctiveness of individual ideas is notably reduced.

Group A was further stratified based on geographic location and the diversity of the flood hazard. In order to examine the different perspectives that result in part from physical variations in flood threat throughout the basin, the sample was divided into two geographic categories: i) City of Winnipeg (urban), and ii) southern Manitoba (primarily rural). For this study, southern Manitoba encompassed the region extending from the

Floodway Inlet at St. Norbert south to the International Border at Emerson. A total of 15 respondents were obtained from each of these categories to create the total sample of 30 Flood Area Residents. The stratification scheme was devised in conjunction with the diverse settlement patterns throughout the basin (see sections 1.6.1 and 1.6.4).

In order to adequately assess the different viewpoints presented by the Flood Area Residents, it was necessary make their group larger numerically. Group B was smaller in size because there are fewer agencies (and thus fewer Institutional Representatives) in the basin dealing with flood-related issues than there are local residents. Accordingly, the 12 respondents in Group B were further stratified into categories based on their level of institutional representation: i) senior government representatives (6 in total), ii) local government representatives (3 in total), and iii) non-government representatives (3 in total). Table 3 provides a complete breakdown of the respondent stratification.

Table 3: Respondent Stratification for the Research Study

Group A: Flood Area Residents	
- City of Winnipeg	15
- Southern Manitoba	15
Total Number of Flood Area Respondents	**30**
Group B: Institutional Representatives	
- Senior Government	6
- Local Government	3
- Non-Government	3
Total Number of Institutional Respondents	**12**
Overall Total Number of Respondents	**42**

3.2.3 – Identification and Selection of Respondents

As outlined in the previous section, the respondents were divided into two groups. Flood Area Residents were selected in order to analyze perceptions of risk from the

perspective of local citizens. Institutional Representatives were chosen in order to analyze perceptions of risk from the perspective of decision makers and their respective institutions. Based on resources available for the risk management module, I was able to offer Flood Area Residents who successfully complete all phases of the research (face-to-face interview and the mail-out surveys) a sum of $50.00. This remuneration was intended to serve as an incentive and as a token of appreciation for participation. It was guaranteed to applicable respondents from the outset of contact by written agreement.

Group A respondents from the City of Winnipeg were identified through the following methods. First, I contacted the City of Winnipeg and requested a list of addresses and contact information for City homeowners that were at risk from flooding in 1997 and required protection from temporary secondary dikes. These homes are not protected by the primary dike system and require sandbags during flood events (i.e. they are located on the river side of the primary dikes). The City provided me with a spreadsheet list of 510 properties, but the requested contact information for homeowners was not provided. As such, the list was reduced to 170 addresses through random selection and an online address-locating program was utilized to obtain postal codes for these addresses. This list of properties was further reduced to a total of 90 addresses, as 80 properties were eliminated because they were identified as apartment blocks, businesses, or private listings for which postal codes were not available.

Formal letters were then mailed to each of the 90 addresses; indicating the purpose of the research and requesting an adult member of the household to act as a participant in the study (see Appendix 2). Letter recipients could indicate their willingness to participate by calling me directly or by filling out and returning a form

attached to the bottom of the letter (a postage paid, return marked envelope was included with the mail-out). A total of 17 letters of interest were returned and I contacted each individual by telephone to confirm their participation. The final sample was comprised of 15 respondents, as 2 respondents were eliminated because they could not be reached despite numerous attempts.

Group A respondents from southern Manitoba were identified through the following methods. First, the research team contacted the council offices of seven flood affected Rural Municipalities (RM) in southern Manitoba and requested a list of 10 to 25 names and contact information for homeowners in each RM that had been at risk during the 1997 flood. After all requested lists were received, a master list with a total of 164 names and addresses was compiled. From this list I randomly selected 90 addresses and mailed out formal letters. The letters, similar in content to those sent to City of Winnipeg respondents, explained the purpose of the research and requested that an adult member of the household participate in the study (see Appendix 3). Due to time constraints, the letter recipients were asked to telephone me and indicate their willingness to participate; rather than using the participation form via standard mail that had been used previously. In total, I received 15 calls from residents indicating potential interest in the study and follow-up phone calls were conducted to confirm participation. The final sample consisted of 15 respondents.

Group B respondents, Institutional Representatives, were identified through the following methods. Based on personal experience and documentation in the literature, the research team created a list of pertinent institutions that had a role in flood management in the Red River Basin. From this list the research team identified key

personnel (i.e. directors, assistant directors, or program leaders) at these institutions who would be the most desirable to approach for participation in the study. I then contacted these appropriate representatives at five senior government organizations (two representatives worked within the same organization), three local government organizations, and three non-government organizations and formally requested their participation in the study. The sample for the local government category was intended to be slightly larger, but due to changes in government since 1997 many elected officials were new to their positions and might not have been directly involved in managing a significant flood event. A fourth non-government organization was also approached to participate, but the suitable representative was unavailable during the interview period.

Senior government representatives were identified from organizations involved in the day-to-day planning and management of flood-related issues. Organizations surveyed included the Water Branch formerly of Manitoba Conservation (now within the Department of Water Stewardship), Manitoba Health Disaster Management Services, Manitoba Emergency Measures Organization, City of Winnipeg Water and Waste Department, and the former Office of Critical Infrastructure Protection and Emergency Preparedness (now Public Safety and Emergency Preparedness Canada). Local government representatives were identified as people who had been elected to represent their municipality. Municipal or local level involvement included the City of Winnipeg, the RM of Ritchot, and the RM of Morris. Non-government representatives were selected from non-profit and not-for-profit groups that play a role in flood emergencies in the basin. Representatives from the Salvation Army, Red River Basin Commission, and

the Mennonite Disaster Service/Mennonite Central Committee participated. The final sample consisted of a total of 12 Institutional Representatives.

3.2.4 – Delphi Process Phase One: Face-to-Face Interviews

Phase One of the Delphi Process was intended to serve as an idea generating strategy and involved a total of 42 participants. In accordance with the literature, this first phase was necessary in order to determine and identify the pertinent issues on the subject being researched (Needham and de Loe, 1990). In previous studies using the Delphi technique, researchers employed a pre-Delphi survey or utilized the first mail-out round of the process to determine and identify the pertinent issues (Richey et al., 1985). Based on personal experience with the technique (Bardecki, 1984), Bardecki (2002) recommended the use of preliminary face-to-face interviews as a more robust method for ensuring the success of the subsequent mail-out portion of the Delphi Process.

As noted earlier, after the respondents had been identified and selected, I conducted phone calls to each of the respondents to reiterate the purpose of the research and requirements of the study. Once agreement with a respondent had been reached, I set up in-person interviews at the respondents' home or in some cases place of business. Interviews were scheduled in two-hour intervals, although some intervals varied depending on the time required for travel between interview sites. Attempts were made to schedule interviews in close geographic proximity on the same days in order to reduce travel costs and for efficiency. A total of 42 interviews were conducted over a three-month period. The average interview lasted 1.5 to 2 hours with the shortest interview lasting for 50 minutes and the longest interview lasting for over 3 hours.

Two members of the risk management module research team were present at each interview. I led the interviews and the second research team member participated as an observer; both of us kept detailed notes from the interviews and later cross-referenced them. Respondents were queried via phone prior to the meetings if having two researchers present was acceptable to them and all graciously assented. Initially, I presented each respondent with an introductory letter that explained the purpose and methods of the research study (see Appendix 4). In addition, an 'Informed Consent Form' was presented to all respondents; signatures were made in each other's presence and both parties retained a copy (see Appendix 5). The consent form reiterated the research purpose and explicitly stated that the research had ethics approval from the Joint-Faculty Research Ethics Board of the University of Manitoba. Contact information for the Human Ethics Secretariat was also provided.

Subsequently, the discussion component of the interviews would commence and I would gather respondents' views on flood-related issues (guided by the use of an exploratory survey instrument). The instrument utilized for the interviews with Flood Area Residents (see Appendix 6) was separate, but similar to the instrument utilized with Institutional Representatives (see Appendix 7). It was decided that separate, but similar instruments were required to address the issues for each group of respondents. Some issues pertinent to Flood Area Residents may not have been relevant when posed to an Institutional Representative and vice versa. Further reasoning for the use of separate survey instruments is addressed in section 3.2.6.

The survey instrument posed a brief, open-ended question that was intended to stimulate discussion and allow the respondents to identify issues that they deemed to be

important. The intention was to allow respondents to discuss personal issues surrounding flooding and flood management, rather than to have me lead the discussion. The instrument also included semi-structured statements (derived from themes and topics in the literature) that were anticipated to stimulate discussion in the event that respondents did not initiate sufficient dialogue on their own. In the majority of interviews the respondents willingly presented their issues and concerns with little prompting. Once the discussion was completed the pre-determined statements were addressed. In total, over 200 pages of data were compiled and transcribed from the 42 interviews.

The critical issues identified during these Phase One interviews served as the basis for the subsequent Phases Two and Three of the Delphi Process, a two-round mail-out Delphi survey. The overall purpose of the face-to-face interview phase was for issue identification, i.e. it served as an idea generating strategy (Needham and de Loe, 1990). In addition to idea generation, the preliminary face-to-face interviews were anticipated to be a means for stimulating interest and engaging participation in order to ensure high motivation for the subsequent mail-out Delphi Process.

3.2.5 – Data Analysis

The primary data collected from the face-to-face interviews and two-round mail-out surveys were analyzed in three separate stages, each following the completion of a phase of the Delphi Process. The first stage of analysis involved examining the data collected during Phase One; I had taken detailed notes during each interview and had transcribed the data into an electronic format. Since this study was part of the risk management module, the next step in the data analysis involved collaboration with the research team. Along with the other members of the research team, I synthesized the data

collected in Phase One during roundtable meetings over a three-month period. Notes from each interview were reviewed and the key issues were identified (see below for further detail). Since two researchers were present at each interview, two sets of notes existed for each interview. We cross-referenced and verified our notes to ensure that the respondents' views had been accurately recorded. At this point each respondent was designated a code number for ease of analysis and to ensure anonymity during subsequent phases of the Delphi Process.

Since the interviews had been primarily open-ended in structure, a considerable amount of information was generated. To reduce the data set into a manageable size, the research team delineated the scope and identified major themes and sub-themes. At the roundtable meetings each issue identified by the research team was recorded as a statement onto 3 x 5 inch note cards and divided into separate Flood Area Resident and Institutional Representative groups. Wherever possible the respondents' original wording was utilized on the note cards. The statements on each note card represented one of the four themes comprised within the overall risk management module: A – risk perception, B – risk communication, C – partnerships, and D – general floodplain management. As such, each note card was correspondingly coded – A (yellow), B (pink), C (blue), and D (purple) – to verify which theme the statement on the card belonged to. I focused solely on the data that contained issues related to theme A – risk perception and the other research team members were responsible for the remaining three theme areas.

To further refine and clarify the data, each theme area was divided into four sub-theme areas. These sub-themes were developed based on commonalities among the issues generated in Phase One: 1) flood and floodplain management, 2) emergency

management, 3) compensation, recovery, and rehabilitation, and 4) flood forecasting, long-term prediction, and uncertainty. All of the issue cards were placed into their corresponding sub-theme areas. Once again, I was only responsible for identifying and recording the issues that were pertinent to each of these four sub-theme areas that were within theme A – risk perception and the other research team members addressed the sub-theme issues that pertained to the remaining three theme areas.

With the overarching themes and sub-themes outlined, the research team went through each note card that contained individual issues and organized them based on the pertinence of the issue and frequency of response. Each issue was then transcribed and a list for each sub-theme area was compiled. I compiled and reviewed the lists pertinent to theme A and synthesized them into 10 to 20 major issues. In some instances more than one respondent had stated the same issue and worded it differently, so these issues were combined into one common, all encompassing statement. The research team then thoroughly reviewed each list and identified and prioritized the issues based on: 1) the frequency of mention by respondents, 2) apparent significance, as determined by the researchers with reference to the literature, and 3) based on the needs of the researchers and the scope of their study. A master list of 40 issue statements was then compiled that contained the 10 most important synthesized issues from each of the four theme areas.

3.2.6 – Delphi Process Phase Two: Mail-Out Delphi Survey #1

Following the first stage of data analysis, the 40 issue statements were organized into a survey booklet format. In accordance with the Delphi process outlined by Turoff (1975), Delbecq et al. (1975), and de Loe and Wojtanowski (2001), the research team developed the survey in order to determine initial positions on the synthesized issues and

to assess the underlying reasons for agreement or disagreement with the statements. The survey format was semi-structured and utilized a combination of synthesized issues derived from the Phase One interviews, as well as literature issues deemed pertinent by the researchers due to significance to the scope of their study.

According to Jones (1975), "in many situations it might be advisable to run separate Delphis using more homogeneous groups of experts in order to highlight areas of disagreement" (p.160). Based on similar inferences from the literature and recommendations from Bardecki (2002), Phases Two and Three of the research involved conducting two separate, but simultaneous, Delphi surveys to obtain clear, divergent opinions. One Delphi was administered to Institutional Representatives, asking more specific and knowledge-based questions, and another separate Delphi was administered to Flood Area Residents, asking less technical and more subjective questions. This distinction was necessary and predicated by the data generated during Phase One.

Following the preparation of draft versions of the surveys, the research team held a roundtable meeting at the Natural Resources Institute, University of Manitoba with the other members of the CURA Flood Research Partnership project. The purpose of this session was to have other experienced academics review the survey instruments for grammatical inconsistencies and to provide comments on the potential effectiveness or limitations of the survey that may have been overlooked by the research team. Meeting participants noted that some of the statements were too vague and ambiguous and others contained multiple issues that may confuse the respondents. Through the insightful aid of the meeting participants, the research team was able to refine the survey instruments.

Following the revisions, the surveys were pretested with four impartial, non-sample representatives (two for the Flood Area Residents survey and two for the Institutional Representatives survey). Based on the pretesting it was determined that the surveys were too large and required too much time (in excess of two hours for a devoted pretest respondent). As such, the research team reviewed and reduced each survey. The Flood Area Resident survey was condensed into 25 statements (see Appendix 10) and the Institutional Representative survey was condensed into 24 statements (see Appendix 11).

The statements were organized into question format, ordered based on the four sub-theme areas (see section 3.2.5), and numerically identified in the booklet for subsequent analysis purposes. Each statement included a Likert scale to determine the respondents' positions with respect to the statement. A Likert scale is a form of rating scale used to determine attitudes or reactions by measuring the strength of agreement or disagreement concerning a specific statement (URL #1). The respondents were also asked to provide reasoning for their agreement or disagreement with the statement.

The Delphi surveys were administered to all respondents through traditional mail-out methods and were sent to the respondents' personal home or business addresses. The mail-out package also included a cover letter that briefly explained the phase of the study, noted the ethics approval for the study, and provided contact information for the researchers (see Appendices 8 and 9). Some of the material in the cover letter reiterated information provided during the Phase One interviews. Instructions for the survey were also presented on the first page of the survey to ensure that respondents were clear on their responsibilities. Also included was a return-marked envelope with prepaid postage so that the respondents could easily return the surveys to the research team.

A total of 42 surveys were mailed out in Phase Two of the Delphi Process. This was the total number of respondents who had participated in the Phase One interviews. One week after mailing the surveys I telephoned each individual respondent and conversed directly with them or left a message that indicated the surveys were in the mail and would be received sometime over the next few days. The surveys included detailed instructions (as noted above) and clearly specified a return date that allowed approximately three weeks for completion depending on the date of receipt.

After the return deadline had passed I conducted follow-up telephone calls to those respondents who had not yet returned the survey (approximately 50% of the sample). Some respondents indicated that they had forgotten or had not yet been able to complete and return the survey, but intended to as soon as possible. Following another three-week period, I again conducted follow-up calls to those respondents with outstanding surveys. Once more, similar reasons were cited and most respondents agreed to complete the survey. Within two weeks the last few surveys were returned and only two Flood Area Residents refused to complete the survey (due to undisclosed personal reasons). Two Institutional Representatives did not complete the survey because of job-related time constraints. A total of 38 surveys were returned for a response rate of 91%. This figure can be broken down further into 28 out of 30 Flood Area Residents (93%) and 10 out of 12 Institutional Representatives (83%).

3.2.7 – Data Analysis

The second stage of the data analysis involved transcribing and synthesizing all of the responses from the Phase Two Delphi survey. The research team analyzed the Phase Two survey over a two-month period after all of the surveys were returned. Initial

analysis involved compiling the Likert scale responses into a spreadsheet database. I created separate tables for each statement from the survey that had addressed an issue related to risk perception (theme A). Following prior procedures, the analysis separated Flood Area Residents' responses from Institutional Representatives' responses. Each table provided a breakdown of the respondents who strongly agreed, agreed, disagreed, or strongly disagreed with the statement posed in the survey (see Chapter 4).

Another important feature analyzed during this stage was the comments or reasoning for agreement and disagreement provided by the respondents. I transcribed all of the responses to each statement and then organized the comments according to the Likert scale responses that they corresponded with (e.g. all comments that resulted from Statement #1 and were marked strongly agree were compiled together, all of those marked agree were compiled together, and so forth). Thus, in the end I had an envelope for each statement that contained five groups of responses: 1) strongly agree comments, 2) agree comments, 3) disagree comments, 4) strongly disagree comments, and 5) no response comments (where applicable).

The next step in the analysis of the results from Phase Two of the Delphi Process involved the use of roundtable meetings with the research team. The research team reviewed each original statement and the corresponding tables of Likert scale responses and then thoroughly analyzed the related comments and reasoning. In accordance with the next step of Delphi process outlined by de Loe and Wojtanowski (2001), the research team summarized the various group comments and reasoning into single phrases that would be included on the Phase Three survey. For example, for Statement #1 there were five respondents who agreed with the statement. The research team reviewed each of the

five comments and reasoning that explained the respondents' agreement with the original statement and then synthesized them into a summary response statement that captured the position of those respondents who agreed with the statement. This process was repeated for all of the other Likert scale options and conducted for each statement on the survey.

In order to help ensure continued participation in the final round, the research team decided to reduce the size of the survey and decreased the total number of statements on the Phase Three survey. To remain consistent, the research team utilized the same criteria that were applied in analyzing the Phase One responses: 1) the frequency of mention by respondents, 2) apparent significance, as determined by the researchers with reference to the literature, and 3) based on the needs of the researchers and the scope of their study. Accordingly, the research team reduced the final number of statements carried forth onto the Phase Three survey to a total of 12 for both the Flood Area Residents' survey and for the Institutional Representatives' survey.

3.2.8 – Delphi Process Phase Three: Mail-Out Delphi Survey #2

Phase Three of the Delphi Process, the final phase, consisted of a survey in booklet format similar to the one developed in Phase Two. Once again separate surveys were used for Flood Area Residents (see Appendix 14) and Institutional Representatives (see Appendix 15). Each page of the Phase Three Delphi survey contained one original statement carried forth from the Phase Two survey. The pages were structured as follows (from top to bottom): the original statement was reprinted; below the statement was a table that contained the total percent of responses to the statement, the summary response statements for each Likert scale level, and space for the respondent to comment on the summary response statements; below the table, the original statement was reprinted and

then a new Likert scale was provided. The intention was to allow respondents to review the original statement, view and reflect on the collated group responses to the statement (from Phase Two), and then re-evaluate their own personal position with respect to the original statement. The purpose was to verify original reasoning and to assess whether viewing the summarized group responses caused the respondents to change their original position with respect to the issue and move towards or away from the group consensus.

The research team followed the same process that was utilized with the Phase Two survey for distributing the Phase Three survey. A total of 38 surveys were mailed out in Phase Three of the Delphi Process; this was the total number of respondents who had completed both Phase One (the face-to-face interviews) and Phase Two (the first mail-out survey). Once again, one week after mailing I phoned each respondent and conversed directly with them or left a message that indicated the surveys were in the mail and would be received sometime over the next few days. The surveys included: detailed instructions, a return date that was approximately three weeks away depending on the date of receipt, and a cover letter – all similar to Phase Two (see Appendices 12 and 13).

After the return deadline had passed I conducted follow-up phone calls to respondents who had not returned the survey (approximately 25% of the sample). Yet again, some respondents indicated that they had forgotten or had not been able to complete and return the survey but intended to as soon as possible. Two respondents expressed regret for having lost their surveys but were still willing to complete them, so replacements were sent out. After another two-week period I conducted another round of follow-up calls to those respondents with outstanding surveys. Once more the respondents expressed their regret and agreed to complete the survey; within one week

the remaining surveys were returned. All Flood Area Residents participated in Phase Three of the Delphi Process; however, two Institutional Representatives did not complete the survey due to job-related time constraints. A total of 36 surveys were returned for a response rate of 95%. This can be broken down further into 28 out of 28 Flood Area Residents (100%) and 8 out of 10 Institutional Representatives (80%).

3.2.9 – Data Analysis

The third and final stage of data analysis involved examining responses from Phase Three of the Delphi Process and followed the framework developed in the prior two stages of data analysis. First, I compiled the Likert scale responses into a spreadsheet database and created separate tables for each statement that addressed a risk perception issue. Again, the analysis was separate for Flood Area Residents and for Institutional Representatives and each table provided a breakdown of respondents who strongly agreed, agreed, disagreed, strongly disagreed, or had no comment with respect to the original statement posed on the Phase Three survey. I also developed a set of tables that presented the Likert scale responses from both the Phase Two and Phase Three surveys. These tables allowed for the direct comparison of Phase Three responses with those from Phase Two and displayed any noticeable changes in position by the respondents. The results and discussion of these tables are addressed in Chapters 4 and 5.

In addition to the Likert scale responses, I analyzed the comments provided by each of the respondents in response to the summary response statements. First, I transcribed all of the responses to each summary response statement and then organized the comments according to the Likert scale response they corresponded with (e.g. all comments that resulted from Statement #1 and were marked strongly agree were

compiled together). In the end, the research team had a separate file for each original statement that contained four groups of responses: 1) strongly agree comments, 2) agree comments, 3) disagree comments, and 4) strongly disagree comments.

The original research design was developed with the understanding that both Delphi surveys would continue for a total of three rounds. However, as discussed in section 3.1.3, the total number of rounds that a Delphi continues for is flexible and the reiteration of a Delphi process should end when the research team is no longer gaining new and relevant data. After analyzing the data from the Phase Three survey the research team determined that the Delphi Process was no longer generating sufficiently new ideas or meaningful responses. The respondents had already provided information that met the intended goals of the project. Since the amount and content of the information generated by the Delphi Process was sufficient, the research team decided to end the research after two mail-out rounds and eliminated the third round of mail-outs as per notation in the literature (see Delbecq et al., 1975; de Loe 1995; de Loe and Wojtanowski, 2001).

Studies using the Delphi technique typically have poor response rates and high dropout rates that tend to be a significant limitation of the technique. To minimize this weakness I utilized a number of methods that were successful. The use of face-to-face interviews (Phase One) was intended to build relationships with respondents and provide them with a vested interest in the study in order to help ensure high motivation and continued participation. The use of follow-up telephone calls to remind participants of the importance and relevance of their input to the study and flexible return dates also aided the high response rates. Additionally, the monetary remuneration, albeit minimal at

$50.00, provided further incentive for those respondents who may have normally become disengaged and withdrawn from such an intensive process.

The overall response rate from Phase One through to Phase Three of the Delphi Process was 36 out of 42 (86%). The response rate can be further broken down into 28 out of 30 Flood Area Residents (93%) and 8 out of 12 Institutional Representatives (67%). Table 4 provides a detailed itemization of the response rates for Phase Two, Phase Three, and the entire Delphi Process as a whole.

Table 4: Summary of Response Rates for the Delphi Process

	Surveys Mailed Out	Surveys Returned	Response Percentage
Delphi – Phase Two	**42**	**38**	**91%**
Flood Area Residents	30	28	93%
Institutional Reps	12	10	83%
Delphi – Phase Three	**38**	**36**	**95%**
Flood Area Residents	28	28	100%
Institutional Reps	10	8	80%
Total Both Phases	**42**	**36**	**86%**
Flood Area Residents	30	28	93%
Institutional Reps	12	8	67%

The final stage of data analysis involved reviewing all of the data and making comprehensive conclusions and recommendations based on the research objectives. These conclusions and recommendations can be reviewed in detail in Chapter 6.

CHAPTER 4

FLOOD RISK PERCEPTION IN THE RED RIVER BASIN, MANITOBA

4.1 – Introduction

The goal of this chapter is to present and analyze the results of the empirical investigation concerning the perception of flood risk in the Red River Basin. The first part of the chapter deals with perception issues identified by Flood Area Residents and the latter part deals with issues identified by Institutional Representatives. Pertinent issues were identified during the Phase One interview process and then followed through a progression during subsequent phases of the Delphi Process. In some cases the Delphi Process was discontinued after Phase Two as some issues were not carried forward into the final phase (Phase Three). In these instances it was determined that the information provided up to that point (the end of Phase Two) was sufficient and there was no need for further investigation of the particular issue. The issues carried forward into Phase Three represented areas where the potential for additional in-depth examination existed based on the Phase Two findings and where there was relevance to the scope of the study.

4.2 – Flood Area Residents

As discussed in Chapter 2, an awareness and understanding of local residents' perceptions of risk is pivotal to hazard and disaster management. In order to make robust management decisions that reduce vulnerability and foster sustainability, decision makers must have an awareness of local residents' perceptions of risk. Additionally, local citizens need to be involved in and aware of decision-making processes that affect their response to a disaster event. A prepared and informed public will create an environment in which the management of a disaster event is more likely to be successful.

Due to the open-ended nature of Phase One of the Delphi Process, large amounts of data were generated that required thorough analysis to establish central issues. Phases Two and Three provided additional reasoning and comments with respect to these issues and allowed for the selection and verification of attitudinal positions. The following nine sub-sections present the results from the analysis of Phase One and also the results from the analysis of the issues that were explored in Phase Two. Of the nine issues explored in Phase Two, five were deemed pertinent and carried forth for further analysis in Phase Three. The results of this final analysis are also provided where applicable.

4.2.1 – Expert Knowledge

The first notable issue pertaining to risk perception that was raised by a number of respondents during Phase One of the Delphi Process was summarized into the following statement and presented on the Phase Two survey.

> *Experts in floodplain management (e.g. people with specialized knowledge) see the problem of flooding from very narrow perspectives because many of them do not live in the flooded area.*

The above statement was formulated on the basis that many South respondents expressed concern that all of the key decision makers involved in flood management live in and make decisions from within Winnipeg. A common perception among these respondents was that non-local residents who are largely unaware of the local region and pertinent community concerns are making the decisions that affect their lives and local communities. The results of the responses to this statement posed in Phase Two of the Delphi Process are noted in Table 5.

The present study is not representative of the population in the Red River Basin and the numeric values in the proceeding tables are not intended to be interpreted as

samples to represent the entire population. The tables and their numeric content were utilized to draw an understanding and recognition of patterns within the sample and no attempts were made to infer about the larger population based on these numbers. Within all tables, the following notations were used: WG = Winnipeg respondents, S = South respondents, SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree, NC = No Comment, DQ = Disqualified. The numeric ordering of the questions is not sequential because the surveys were part of the broader risk management module.

Table 5: Delphi Phase Two – Expert Knowledge

Flood Area Residents' Responses to Question #5									
	WG	**WG %**	**S**	**S %**	**Total**	**Percentage**		**Total A / D**	**Total Percent**
SA	1	7%	5	36%	**6**	**21%**			
A	5	36%	5	36%	**10**	**36%**		16	57%
D	5	36%	3	21%	**8**	**29%**		8	29%
SD	0	0%	0	0%	**0**	**0%**			
NC	3	21%	1	7%	**4**	**14%**		4	14%
DQ	0	0%	0	0%	**0**	**0%**		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

Overall, the majority of respondents agreed with the statement (i.e. 16 out of 28) that expert perspectives are too restricted. A geographic difference of opinion was exhibited, as Winnipeg respondents were somewhat divided on the issue (i.e. 6 in agreement and 5 in disagreement) and South respondents were decidedly more in agreement (i.e. 10 in agreement and 3 in disagreement).

The common perception among the respondents who agreed with the statement is that decision makers and managing authorities lack the firsthand experience that comes from being a local resident on the frontlines fighting flood events. The respondents felt that an important component of managing an event is knowledge of the local region and experience with past flood events in the community.

Experts who make decisions without consulting local people do not have the actual experience that local people have. [South respondent #04]

On paper or computer it may look one way, these people aren't getting wet, sandbagging their belongings or cleaning up after. [South respondent #11]

I agree with this statement, it is very important; there should be discussion and communication between people with specialized knowledge and people who have lived through 3, 4, and 5 floods to plan for future floods. [South respondent #08]

One needs to "live through" this situation. Floodplain management from above just is unrealistic. All partners need to be involved. [Winnipeg respondent #13]

Alternatively, respondents who expressed disagreement with the statement provided a different line of reasoning that supported experts' perspectives.

People who do not live in a flooded area may see things from an entirely healthy perspective because they are not bogged down with emotional baggage and are not focused on issues such as compensation, attachment to place or community identity. [South respondent #09]

Not necessary to live in the area for "experts" to know what they're talking about. [Winnipeg respondent #02]

If they are truly "experts" they understand the impact clearly. If they don't, they aren't experts and should be replaced. [Winnipeg respondent #06]

Those respondents who disagreed with the statement appear to have had positive experiences with institutional representatives during the 1997 flood. The respondents indicated that the experts are generally quite capable in their positions and do not see living in a region as necessary to provide proper decision-making. As one respondent noted, it may be healthy to have an external and unbiased person making decisions.

One variable that may have an influence on such perceptions of expert knowledge and experience at the local level is the actual threat faced by the particular respondents during the 1997 flood. For example, respondents whose homes were flooded and who experienced mandatory evacuation may have a different perspective than those

respondents whose homes were saved or not significantly damaged and who did not experience mandatory evacuation. The potential reason being the particular institutional representatives which homeowners would have dealt with in the case of the former.

In 1997 the mandatory evacuation and post-flood claims process were fairly contentious, during Phase One many South respondents noted that going through these events was more difficult than coping with the actual flood event. Many respondents noted personal experiences during and after the 1997 flood where government officials dealing with local residents were unfamiliar with local situations. In many cases this aggravated situations and led to feelings of resentment among many South respondents. These respondents felt as though they were being ignored and that their knowledge was inferior in the eyes of the experts from Winnipeg. The perception that experts lack an awareness of local community experiences likely developed in part from the respondents' experiences with these contentious processes. Many of the respondents in this study who agreed with the statement had gone through the mandatory evacuation and through the Manitoba Emergency Measures Organizations' (MEMO) claims process.

4.2.2 – Trust, Credibility, and the Affect Heuristic

Another notable theme identified in the Phase One interviews was the notion of trust and credibility. A number of respondents raised concerns that based on their personal experiences during the 1997 flood institutional representatives were not trustworthy and credible. In accordance with Slovic's (1997) reasoning on the affect heuristic, it was hypothesized respondents who had negative experiences with institutional organizations in 1997 would still have negative feelings that would influence

future dealings with these organizations. Consequently, the following statement was formulated and presented on the Phase Two Delphi survey.

> *My experience with governmental agencies, during and after the 1997 flood, has led me to believe that they are not trustworthy or credible, and as such I have strong negative feelings towards them. These negative feelings will affect my future decisions in dealing with these agencies.*

In response to this statement, respondents provided the following results (see Table 6).

Table 6: Delphi Phase Two – Trust, Credibility, and the Affect Heuristic

Flood Area Residents' Responses to Question #6									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	1	7%	5	36%	6	21%			
A	0	0%	2	14%	2	7%		8	28%
D	4	29%	5	36%	9	32%		17	61%
SD	8	57%	0	0%	8	29%			
NC	1	7%	2	14%	3	11%		3	11%
DQ	0	0%	0	0%	0	0%		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

The majority of respondents expressed disagreement with the statement (i.e. 17 out of 28) and did not retain negative feelings from the actions of government during the 1997 flood. Based on the Phase Two responses, there appears to be a divergence between the perceptions of Winnipeg and South respondents. The majority of Winnipeg respondents (i.e. 12 out of 14) expressed disagreement with the statement and South respondents expressed greater agreement (i.e. 7 in agreement and 5 in disagreement).

A number of South respondents who disagreed with the statement cited that any problems or negative feelings were specific to events that transpired during the 1997 flood and would not be carried forward into dealings in future flood events.

> *I believe the problem was more one of people in government agencies being incompetent in their positions. During the flood and early after civil servants got put into positions they were not trained to handle. I personally berated a person who did not deserve it because he honestly did not know what he was doing with MEMO. I did not realize it until several months later. No one wins!* [South respondent #02]

Fairly satisfied with our personal experience with government agencies for diking our property and compensating us for our losses. [South respondent #04]

Many of the government agencies were not untrustworthy because to most of them all these situations were just as unknown. For a lot of people there was a lack of knowledge and information on how to deal with as much water as we had during the 1997 flood. [South respondent #08]

The flood affected people pressured government to a fast action recovery after the flood and untrained people were sent out – EMO people need sound training for flood situations. [South respondent #15]

While the majority of South respondents agreed with the statement, the reasoning provided in Phase Two was ambiguous and did not identify specific organizations that were viewed negatively. These South respondents did not provide any noteworthy reasoning that could explain the strong negative associations that had been conveyed during the Phase One interviews in reference to specific institutional organizations. In fact, the responses provided by the smaller number of South respondents that disagreed with the statement were more articulate and clearly detailed the reasons that negative associations would not be made.

According to the reasoning provided by many Winnipeg respondents, it appears that the 1997 flood event was viewed as a more positive experience within the City.

During and after the 1997 flood our experience was that agencies and workers did a very good job of informing, advising, and assisting us within their areas of jurisdiction. [Winnipeg respondent #07]

We were treated more than fairly. I might not agree with all the decisions that were made but I feel these people tried their best. [Winnipeg respondent #13]

My experience was positive in 1997 not negative [Winnipeg respondent #02]

I think they coped as best they could in an unpredictable event. I think there were lessons to learn and hopefully they will be on record for another time. [Winnipeg respondent #01]

Overall, the data suggest that within the City of Winnipeg institutional organizations are viewed in a positive light based on the experience of the 1997 flood. Hence, rather than marking them with a negative affective feeling these respondents have marked the organizations with a positive affective feeling that may aid the delivery of services in future events. South respondents were more divided on the subject based on their experiences with specific institutional organizations, but negative associations were not disclosed. It appears that negative associations of the affect heuristic will not play as large a role as originally hypothesized.

4.2.3 – Perceived Flood Recurrence

In accordance with Burton et al. (1993), one of the main notions of risk perception is that laypeople often tend to underestimate or deny the objective or real risk that exists where they reside. During the Phase One interview process respondents were queried about their feelings regarding the likelihood of experiencing another 1997 level flood in their lifetime. The responses were somewhat varied but many respondents indicated that while they felt it was quite likely they would experience another 1997 level flood event, it was not something they worried about on a daily basis. In order to ascertain formal written responses and to investigate the issue further, a statement addressing the perception of flood risk was formulated and included on the Phase Two survey.

A flood equal to or greater in magnitude than 1997 will not occur in my lifetime.

Respondents' results with respect to the above statement can be noted in Table 7.

The majority of respondents expressed disagreement with the statement, a somewhat contradictory finding based on notions in the literature. It was expected that most respondents would indicate that a flood equal in magnitude or greater than 1997

would not happen in their lifetime. Conversely, the majority of respondents indicated that they felt a flood equal to or larger than 1997 would occur at some point in their lifetime. There may be a number of speculative reasons for this heightened perception of risk among the respondents in this study. One such reason may be the temporal proximity of the study to the 1997 flood; although the 1997 flood had occurred more than 6 years prior to the time of the field research, the event was easily recallable for all of the respondents and was still a topic of interest for them. The recency and memorability of the event may have contributed to the heightened perceptions of flood risk.

Table 7: Delphi Phase Two – Perceived Flood Recurrence

Flood Area Residents' Responses to Question #7									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	1	7%	1	7%	2	7%			
A	2	14%	1	7%	3	11%		5	18%
D	4	29%	7	50%	11	39%		18	64%
SD	2	14%	5	36%	7	25%			
NC	5	36%	0	0%	5	18%		5	18%
DQ	0	0%	0	0%	0	0%		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

The key outcome for this particular issue statement was the reasoning provided by the respondents. The small minority in agreement provided the following reasoning.

> *I do not think this will happen in my lifetime.* [Winnipeg respondent #13]
>
> *There is a slight statistical probability of such a flood in my lifetime. Chances are much higher that there won't be such a flood.* [Winnipeg respondent #14]
>
> *We are retired and don't expect another flood.* [South respondent #04]
>
> *I am now 70 years old.* [South respondent #01]

The above respondents appear to be choosing to deny the risk in order to reduce the associated uncertainty (as theorized in the literature). The latter two respondents based their perception on the notion that they are elderly and are not likely to see another

1997 level flood before they die. These responses illustrate a common misperception and misunderstanding of probability and flood recurrence intervals. Granted, without knowing the current status of each respondent's physical health it is difficult to estimate their life expectancy, but assuming the respondents were to live for another 10 years on average, there is a high likelihood that they will experience another significant flood event. The elderly are already a greater at-risk population and the fact that they do not perceive the threat could potentially make them more vulnerable. Decision makers and other institutional representatives should be aware of this important consideration.

The majority of the sample expressed disagreement with the statement and provided a variety of reasons for their heightened perceptions of risk. For instance, some respondents exemplified the fatalist worldview, as noted by Slovic (1997), in which future events are perceived to be inevitable and beyond an individual's control.

> *Only God knows the future.* [South respondent #03]
>
> *Data is only a guideline for future predictions – a person does not know what tomorrow will bring.* [South respondent #15]
>
> *No one knows when the next flood will occur.* [Winnipeg respondent #08]
>
> *A 1997 flood can occur in any year depending on the right factors.* [South respondent #11]
>
> *No one can predict when a series of weather events, which result in a great flood, will occur.* [Winnipeg respondent #07]

Other respondents were of the perception that human intervention into the natural environment has been the cause of large floods and will be the reason for future floods.

> *Americans are improving drainage constantly and dumping more water into the Red River.* [South respondent #14]
>
> *Too many swamps have been drained and continue to be drained.* [South respondent #13]

Each year there is the same chance of flooding. In fact, due to the build up along the rivers the chances are probably increasing gradually. [Winnipeg respondent #03]

While the respondents presented differing reasons for their heightened perceptions of risk, from a management perspective it is an encouraging sign that the majority seemed to recognize the threat and feel it is likely they will experience future flooding. Some respondents even perceived that floods larger than 1997 may occur.

Proof of a much larger flood in the 1800s is there. [South respondent #13]

There will be other floods greater or equal in magnitude – just look at the world's extreme weather activities that have occurred in the past couple of years. We had two big floods back to back in 1996 and 1997. [South respondent #08]

I think a more serious flood could occur. In fact, the same level of flooding with different weather conditions could easily have made the 1997 flood much worse. [Winnipeg respondent #09]

Given the scope of the study and due to the variety and quality of responses, it was determined that this statement would be useful for further examination in Phase Three of the Delphi Process. As such, the original statement was included on the Phase Three survey and respondents were presented with a summary of the Phase Two reasoning and asked to re-evaluate their position with respect to the original statement. The results from Phase Three are noted in Table 8.

Table 8: Delphi Phase Three – Perceived Flood Recurrence

Flood Area Residents' Responses to Question #2									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	0	0%	1	7%	1	4%			
A	2	14%	1	7%	3	10%		4	14%
D	10	72%	7	50%	17	61%		23	82%
SD	2	14%	4	29%	6	21%			
NC	0	0%	1	7%	1	4%		1	4%
DQ	0	0%	0	0%	0	0%		0	0%
Total	14	100%	14	100%	28	100%		28	100%

In accordance with de Loe and Wojtanowski (2001), the second mail-out round of a Delphi process (Phase Three for this study) enables the respondent group to review summaries of group reasoning and provides the opportunity to reassess one's position with respect to the original statement. For this particular statement the respondent group generally retained their original positions and there was no significant variance from original responses. The only noteworthy change was in the overall disagreement with the statement, which increased in Phase Three (i.e. from 18 out of 28 to 23 out of 28). One source for the change may be that those respondents who provided 'no comment' during Phase Two chose to take a position in Phase Three (i.e. from 5 out of 28 down to 1 out of 28). For a further comparison of results from Phase Two and Phase Three see Table 9.

Table 9: Phase Two and Three Comparison – Perceived Flood Recurrence

Flood Area Residents' Responses – Phase Two Question #7 and Phase Three Question #2								
	Total P2	Total P3	Percent P2	Percent P3	Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	2	1	7%	4%				
A	3	3	11%	10%	5	4	18%	14%
D	11	17	39%	61%	18	23	64%	82%
SD	7	6	25%	21%				
NC	5	1	18%	4%	5	1	18%	4%
DQ	0	0	0%	0%	0	0	0%	0%
Total	28	28	100%	100%	28	28	100%	100%

In addition to further investigation of the original statement, the Phase Three survey was intended to allow for the verification of original reasoning; respondents were given the opportunity to provide comments on the summary response statements (i.e. summaries of the overall group reasoning from Phase Two). The research team analyzed all of the comments and noted any new ideas with respect to the original statement. Based on the comments provided on the Phase Three survey, it was determined that for the statement on 'Perceived Flood Recurrence' no knew issues or ideas were generated.

While no new information was generated, the Phase Three survey did validate the reasoning that respondents had provided with respect to the original statement on the Phase Two survey. For instance, the summary response statements generated comments from the respondents that supported the notion that one's age may influence perceptions of flood risk (i.e. perceiving that a 1997 or larger flood will not occur in one's lifetime). Some of the comments provided by respondents included:

> *Given my age (66) this statement and the one below are probably correct.* [Winnipeg respondent #14]
>
> *A somewhat pessimistic outlook but certainly influenced by the age of the respondents.* [Winnipeg respondent #11]
>
> *One's "lifetime" is a factor here – though not expressed. Could be 60 years or 10 years.* [Winnipeg respondent #02]

Also, the notion of risk being an uncontrollable factor beyond the control of local residents was verified through respondent comments.

> *One does not know what life will be like tomorrow or what a day may bring forth. There is no perfect prediction – be prepared for the worst and hope for the best.* [South respondent #15]
>
> *I hope this is a true statement. But nobody knows. It's called risk and uncertainty.* [Winnipeg respondent #08]

Overall, while a small number of respondents chose to reduce their uncertainty and deny the objective risk based on their age, the majority of respondents expressed the perception that flood events equal in magnitude to 1997 or larger will likely occur in their lifetime. Some respondents expressed a fatalist worldview and indicated that while flood threat does exist, it is determined by factors they have no control over. Other respondents also noted that large floods are likely to recur, but they perceived changes to the landscape by human activities and changing weather to be the causal factors. The data

generated from the Phase Three survey supported and verified the issues identified during the Phase Two survey, but no major changes in position or new issues were produced.

4.2.4 – Perceived Flood Frequency

In addition to utilizing issues generated during Phase One, constructs from the literature were also explored. One such issue was that of flood frequency, which is determined using statistical methods (noted in section 1.6.4) and provides an estimation of when the next flood of a given size will occur. According to perception literature (Kates, 1962; Haque, 2000), laypeople tend to misinterpret or misperceive flood frequency. One commonly cited example is that laypeople tend to perceive that when a 1 in 100 year flood event occurs, it means that a flood of equal magnitude will not recur for another 100 years. By sustaining such a perception the layperson has reduced their personal uncertainty by denying or ignoring the risk (i.e. 'I am not in danger because it won't happen for another 100 years'). The following statement was posed on the Phase Two survey in order to determine whether such common misperceptions were present.

> ***Flood frequency*** *(i.e. flood recurrence within a given time) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years, is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

Responses to this statement from the Phase Two survey are detailed in Table 10.

The majority of respondents were in agreement with the statement (i.e. 19 out of 28) and noted that the concept of flood frequency is not well understood by some residents. Unlike the results for many of the other statements, the geographic diversity in perception was not present as both Winnipeg and South respondents had similar response numbers for agreement and disagreement.

Table 10: Delphi Phase Two – Perceived Flood Frequency

Flood Area Residents' Responses to Question #21									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	5	36%	1	7%	6	22%			
A	5	36%	8	57%	13	46%		19	68%
D	2	14%	3	22%	5	17%		6	21%
SD	0	0%	1	7%	1	3%			
NC	2	14%	1	7%	3	11%		3	11%
DQ	0	0%	0	0%	0	0%		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

The reasoning provided by the respondents generated some interesting data with respect to perceptions of flood risk. A number of respondents expressed agreement that it was other residents that did not understand flood frequency and then provided reasoning that illustrated how they personally understand flood frequency and perceive flood risk.

> *Perhaps the thing which is most misunderstood is that the event can take place at any time within 100 years but we just don't know when, could be next year, could be the year after, in 5 years, 20 years, whenever. It will be – we just can't tell you exactly, but based on historic information, current information, Doppler, etc. forecasting will be more accurate and that's the best anybody can do and I accept that.* [South respondent #09]

> *I think that there will be other big floods more often than we can think – flood frequency has occurred more often than every 100 years. We had 3 big floods 1979, 1996, and 1997.* [South respondent #08]

> *This is just statistics – there was quite high water in 1948 and a flood in 1950. If we get into a wet cycle there is likely to be flood events very close together.* [Winnipeg respondent #03]

> *Most people believe that because we had a major flood in 1997 it is unlikely that we'll have another major flood for quite a while. They don't understand that the 1997 floods occurrence does not alter the risk of another occurrence.* [Winnipeg respondent #14]

While the respondents felt that other residents misperceive flood frequency, it was clear that a number of the respondents personally understand flood risk. Herein is the benefit of including reasoning in addition to the Likert scale responses in a Delphi

survey. The reasoning allows for clarification of why respondents chose to agree or disagree with the statement. For this particular issue statement the importance of the reasoning was that it allowed for an understanding as to how the individual respondent perceives flood frequency. As can be interpreted from the above statements, the respondents appear to have a reasonable understanding of flood frequency. These respondents are aware that a 1997 level flood could recur within a short timeframe and expect to experience future flood events in their lifetime. This may in turn lead to a more prepared and less vulnerable population.

Other respondents provided similar reasoning that illustrated how they personally perceived flood risk and how they viewed flood frequency. These respondents qualified their reasoning by attributing the cause of flooding to an uncontrollable power such as God or Mother Nature – a reiteration of the fatalist worldview first noted in section 4.2.3.

> *God is in charge – we mere mortals have no control over the weather.* [Winnipeg respondent #07]

> *It could flood almost every year it just takes the right (or wrong) weather conditions. Soil moisture in fall, river levels, and snowfall give a good indication of what could happen. Get that information out.* [South respondent #14]

> *Who can forecast the future ... Lets just be better prepared in the event it happens and not be formulating plans by the seat of our pants as what went on [in 1997].* [South respondent #03]

Another notable trend that appeared among some Winnipeg respondents was the reiteration of the need for expansion of the Floodway. Many respondents recognized that 1997 was a "close call" and noted that the City remains vulnerable to larger floods. In order to reduce the associated uncertainty these respondents have indicated a desire for an expanded Floodway to reduce the threat that they perceive. While it is encouraging that the respondents generally perceive the objective risk, this exemplifies Winnipeg's

dependency on structural measures and the expectations it has instilled in the City's population. Rather than creating a resilient population ready to deal with flood risk, the structural measures have created a society dependent on physical solutions that will not feel safe until it has the largest physical protection deemed economically feasible.

> *I certainly understand that I could get very wet next spring and I wish the floodway expansion had a higher priority.* [Winnipeg respondent #12]

> *Improvements after the 1950 flood (raising roads and building dikes) didn't work for minor floods – the water simply took different routes. Therefore a major undertaking such as increasing the floodway to prepare for unforeseen high waters is very important for all concerned – ASAP.* [Winnipeg respondent #05]

Those respondents that expressed disagreement generally indicated that they personally understood flood frequency, but did not take the time to indicate how they understood it or what the concept meant to them. Some respondents stated that residents have a grasp on the understanding of probability and do not misinterpret flood frequency. Others felt that human intervention into the natural landscape (primarily improved and additional drainage) was the reason for increased flood frequency since 1950.

Based on the relevance of the issue with respect to the literature and the scope of the study, the original statement was carried forth onto the Phase Three survey. Table 11 provides a breakdown of the responses from Phase Three. A noteworthy adjustment in positions from Phase Two to Phase Three occurred with respect to disagreement. The total number of respondents in disagreement doubled from Phase Two to Phase Three (i.e. 5 out of 28 to 10 out of 28) and the largest shift was among Winnipeg respondents. In Phase Two Winnipeg respondents were primarily in agreement (i.e. 10 in agreement and 2 in disagreement) but in Phase Three those in disagreement increased (i.e. 8 in agreement and 6 in disagreement). While the majority of Winnipeg respondents

maintained agreement with the statement, the instability in their responses (i.e. willingness to change positions) is worth mentioning.

Also of particular note with changing positions were the 'no comment' respondents. Once again respondents who originally had 'no comment' in Phase Two chose to take a position in Phase Three. Reasons for this are unclear but may relate to the summary response statements, as these respondents may have been influenced by the ability to pick a statement rather having to formulate one of their own. Table 12 provides a comparison of Phase Two responses with those from Phase Three.

Table 11: Delphi Phase Three – Perceived Flood Frequency

Flood Area Residents' Responses to Question #11									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	2	14%	3	21%	5	18%			
A	6	43%	7	50%	13	46%		18	64%
D	6	43%	4	29%	10	36%		10	36%
SD	0	0%	0	0%	0	0%			
NC	0	0%	0	0%	0	0%		0	0%
DQ	0	0%	0	0%	0	0%		0	0%
Total	14	100%	14	100%	28	100%		28	100%

Table 12: Phase Two and Three Comparison – Perceived Flood Frequency

Flood Area Residents' Responses – Phase Two Question #21 & Phase Three Question #11								
	Total P2	Total P3	Percent P2	Percent P3	Total	Total	Total	Total
SA	6	5	21%	18%	A/D P2	A/D P3	Percent P2	Percent P3
A	13	13	46%	46%	19	18	68%	64%
D	5	10	18%	36%	6	10	21%	36%
SD	1	0	3%	0%				
NC	3	0	11%	0%	3	0	11%	0%
DQ	0	0	0%	0%	0	0	0%	0%
Total	28	28	100%	100%	28	28	100%	100%

The comments provided on the Phase Three survey did not provide any added value to the research; again they reinforced positions taken on the Phase Two survey. The comments also did not provide any insight as to possible reasons for the instability in

Winnipeg respondents from Phase Two to Phase Three or reasons for the change in 'no comment' respondents. One notable comment provided in Phase Three by a Winnipeg respondent indicated that the Delphi Process might have achieved some unintended goals.

> *Thanks to this questionnaire I understand these concepts better.* [Winnipeg respondent #01]

During follow-up phone calls this respondent reiterated the fact that participation in this study allowed for an opportunity to view different perspectives and to learn. As such, it may be worthwhile for future research in the basin to explore the possible means for using the Delphi Process as a tool for educational purposes.

Overall, while the majority of respondents agreed that some floodplain residents tend to misperceive the concept of flood frequency, the reasoning they provided indicates that the concept is generally understood. A number of respondents perceived that floods can recur at any time and did not view them as cyclical phenomena that only occur every 100 years (as postulated in the literature). Some of these respondents expressed a general understanding of objective risk and the factors that determine flood frequency; others perceived that flood frequency is an uncontrollable facet of life determined by fate.

4.2.5 – Fear, Anxiety, and Stress

During the Phase One interviews, a number of respondents stated that due to past experiences with flood events, whenever the Red River rises above normal levels they are overcome by feelings of fear, anxiety, and stress. Also a noted finding in literature (see Slovic, 1987; Lopes, 1992), this issue was posed as a statement on the Phase Two survey.

> *Extreme events and their impacts are so traumatic that they create permanent memories of fear and anxiety that are recalled in subsequent events. As a result, watching the river rise creates fear, anxiety, and stress.*

A breakdown of the responses to the above statement can be noted in Table 13.

Table 13: Delphi Phase Two – Fear, Anxiety, and Stress

Flood Area Residents' Responses to Question #8									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	3	22%	4	29%	**7**	**25%**			
A	5	36%	7	50%	**12**	**43%**		19	68%
D	2	14%	2	14%	**4**	**14%**		7	25%
SD	2	14%	1	7%	**3**	**11%**			
NC	2	14%	0	0%	**2**	**7%**		2	7%
DQ	0	0%	0	0%	**0**	**0%**		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

The majority of respondents expressed agreement that fear, anxiety, and stress have resulted from past experience with flood events. Proportionally, agreement was slightly higher among the South respondents, which stands to reason given geographic differences in the flood threat. The majority of South respondents lived on individual rural homes or farms in 1997 and as such, were literally surrounded by floodwaters. During the Phase One interviews many South respondents noted being evacuated by boat or travelling by vehicle across roads submerged by floodwaters. The fact that many respondents were evacuated in unsafe conditions may have significantly contributed to the gravity of the flood event and enhanced feelings of fear, anxiety, and stress.

Reasoning provided by some of the respondents who noted agreement with the original statement also illustrated the serious psychological effects of the 1997 flood.

> *That is why my husband had to leave and asked for a divorce. Myself all the trauma took a toll on my health [and] I needed open heart surgery.* [South respondent #01]

> *Waking up in the morning with two feet of water surrounding your house and no boat to get out stays in one's mind forever.* [South respondent #07]

> *I personally still have dreams and anxiety about flood events in both 1950 and 1997. Any time the river is high is extremely stressful for me.* [Winnipeg respondent #03]

> *Especially in the spring along the Red River. We vividly remember the events in 1997. One of my adult children could not sleep for months after "the flood" and*

each spring now sleeps on the chesterfield in the living room close to the front exit until it becomes apparent that there will be no flood. [Winnipeg respondent #07]

It appears that for some respondents the increased stress and uncertainty caused by the memorability of past floods also leads to heightened perceptions of risk. This finding supports the notion that hazards that are characterized as unknown and represent dread for the public are often associated with heightened perceptions of risk for the particular hazard (Slovic et al., 1974).

Some respondents acknowledged that fear, anxiety, and stress were created by the 1997 flood event for some people, but qualified their agreement with reasoning that these outcomes were not of great personal concern to them. While a few respondents experienced significant psychological effects (see above), others were more apt to consider the flood event merely as an experience and some even detailed benefits of the experience (see below).

Extreme events do create permanent memories and stress. I don't feel it is so much of fear because most of us who have lived through many floods have a good idea of what is going on or what will happen. It definitely causes extreme stress. [South respondent #08]

Extreme events also make one wiser, making preparations for high water easier. In 1997 we started preparing in January. [South respondent #02]

Stress should be lessened a great deal now with upgraded floodproofing. [South respondent #14]

Similarly, some of the respondents who disagreed with the original statement also indicated that fear, anxiety, and stress were not an outcome from the 1997 experience.

Though anxiety was created, it did not have any lasting effects. [Winnipeg respondent #09]

I have lived on the river for 44 years [and] through 2 to 3 near floods. NO STRESS. If people are made anxious they should move. [Winnipeg respondent #02]

Watching the river should not create anxiety or fear, but a sign to be prepared for whatever. Everyone has traumatic situations happen in their life and has to learn how to cope and get through it all. [South respondent #15]

Overall, for some respondents the 1997 flood experience had significant psychological effects that have remained to this day and resurface whenever a flood threat is imminent. The resultant fear, anxiety, and stress may contribute to health problems for those that are affected (which may become permanent) and may increase vulnerability during flood times (by decreasing one's physical or mental capacity to respond). Alternatively, other respondents felt that while these events may create fear and anxiety it is up to the individual to deal with this problem. These respondents noted that the 1997 flood was simply an experience and did not have any impact on their lives.

4.2.6 – Additional Flood Protection

During the Phase One interviews a number of South respondents indicated that they felt the government mandated flood protection level of 1997 flood levels plus two feet of freeboard was not adequate. Many respondents stated that when floodproofing their homes after the 1997 flood they chose to go beyond the 1997+2 feet standard and add extra height to their personal dikes. Some respondents expressed a heightened perception of flood risk and cited a desire for higher flood protection to provide a greater sense of security and peace of mind. One respondent reasoned that after originally building a dike during the post-1979 flood period it had settled and he had much less protection than he thought in 1997 – when the floodwaters arrived he had to rush to fill weak spots and low points in the dike. As such, to account for potential settlement the respondent chose to reconstruct his dike at 1997+4 feet of freeboard. Based on these findings the following statement was formulated for the Phase Two survey.

Floodproofing up to 1997+2 feet of freeboard is not adequate to provide a sense of security and therefore additional safety measures (e.g. 1997 + more than 2 feet) are required.

The results provided in response to this statement are noted below in Table 14.

Table 14: Delphi Phase Two – Additional Flood Protection

Flood Area Residents' Responses to Question #9									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	2	14%	4	29%	6	21%			
A	4	29%	5	36%	9	32%		15	53%
D	6	43%	2	14%	8	29%		9	33%
SD	0	0%	1	7%	1	4%			
NC	2	14%	2	14%	4	14%		4	14%
DQ	0	0%	0	0%	0	0%		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

A small majority of respondents agreed (i.e. 15 out of 28) that 1997+2 feet was not an adequate height for flood protection and that higher protection was needed to provide a greater sense of security. Overall, these findings are indicative of the fact that the respondents appear to have an acute sense of the flood threat and perceive that 1997 level floods will recur and that larger floods may occur (see section 4.2.3).

Similar to results in some of the previous sections, there is a notable divergence between responses from South respondents and Winnipeg respondents. While Winnipeg respondents were evenly divided for this statement (i.e. 6 in agreement and 6 in disagreement), a greater number of South respondents were in agreement (i.e. 9 in agreement and 3 in disagreement). Once again, the geographic differences in levels of risk became apparent when the respondents reasoning were reviewed. For instance, some South respondents in agreement detailed reasons for adopting higher flood protection.

If there is an appropriate option to go to a higher level, I believe an extra foot or two should be done. [South respondent #05]

In 1979 we went to 1979+3 and stayed dry in 1997. In 1997 we went to 1997+4. It cost more in the short-term but much less in the long-term. [South respondent #02]

Any earth structure (dikes, dams, roads) always settles with time. Records are always broken (water levels). [South respondent #14]

These respondents appear to be including a number of logical variables in their perception of risk and subsequent adoption of flood protection measures that have come from past flood experience. Since most South respondents have individual flood protection and they are responsible for protecting their own homes, they may be more inclined to go beyond the minimum flood protection level to a height where they feel more comfortable. Another variable that may play a factor in these decisions relates to the flood threat faced by the respondent during the 1997 flood. Some homeowners that were close to being flooded or may have been flooded in 1997 (i.e. faced a higher level of flood risk) may be more inclined to adopt enhanced flood protection beyond 1997+2 feet.

Similarly, many Winnipeg homeowners living on the riverside of the primary dikes require individual flood protection in addition to the protection from the Floodway. Based on their higher level of risk, some of the Winnipeg respondents in this situation indicated that further flood protection beyond 1997+2 feet was required.

Our neighbours voted against floodproofing, leaving 6 houses at the south end of the street (including mine) not adequately protected. Therefore I do not feel secure in the springtime. [Winnipeg respondent #07]

In order to help defray the costs and to utilize government funding initiatives, flood protection programs were offered on a neighbourhood scale after the 1997 flood. A specification of the program was that if the majority of neighbourhood residents did not desire additional flood protection, it was not forced upon them. This was the case for the above respondent, as neighbours at the north end of the street (the higher side that is less

vulnerable) did not want additional flood protection because they felt their homes were safe. Thus, the only option for the respondent living at the south end (the lower side that is more vulnerable) was to remain at current flood protection levels or pay the entire cost individually. Since the latter option was not affordable for the respondent and a scaled down version of the project for the six at-risk homes was not feasible for the City based on cost-benefit, these homes remain at risk while the majority of the neighbourhood remains content and better protected. Without this added flood protection the respondent noted feeling less secure and also exhibited a heightened perception of risk as a result.

The most commonly noted topic among the reasoning of Winnipeg respondents was the issue of Floodway expansion. Unlike most of the South respondents who adopt flood protection measures on a personal level, many of the Winnipeg respondents desire to receive further large-scale flood protection on a collective or community level.

> *Once the floodway is updated we'll be just fine!* [Winnipeg respondent #13]

> *But they should relate to increasing the capacity to move water around the city and into the lake. I suggest deepening the ditch!* [Winnipeg respondent #10]

> *1997+2 is essentially the level of the primary dikes. That is and should be sufficient for secondary dikes using temporary structures. It is essential that the whole city be protected beyond that level by engineering such as an expanded floodway.* [Winnipeg respondent #06]

In addition, some Winnipeg respondents were content with the existing level of protection and did not desire enhanced personal or collective flood protection.

> *In our area and for our home 1997+2 [is] adequate.* [Winnipeg respondent #09]

> *I suspect the statement is correct, but I'm comfortable with 1997+2.* [Winnipeg respondent #08]

> *1997+2 feet is adequate if [the] base is solid throughout and access is legislated, with clear plans in place and no immovable obstructions. We get ample warning of approaching water volumes.* [Winnipeg respondent #12]

Based on the diversity of reasoning and requirements of the study, this issue was pursued further and the statement was carried forward onto the Phase Three survey. Subsequent results from the Phase Three survey are noted in Table 15.

Table 15: Delphi Phase Three – Additional Flood Protection

Flood Area Residents' Responses to Question #3									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	4	29%	6	43%	**10**	**36%**			
A	7	50%	3	21%	**10**	**36%**		20	72%
D	2	14%	4	29%	**6**	**21%**		6	21%
SD	0	0%	0	0%	**0**	**0%**			
NC	1	7%	1	7%	**2**	**7%**		2	7%
DQ	0	0%	0	0%	**0**	**0%**		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

Table 16: Phase Two and Three Comparison – Additional Flood Protection

Flood Area Residents' Responses – Phase Two Question #9 and Phase Three Question #3									
	Total P2	Total P3	Percent P2	Percent P3		Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	**6**	**10**	**21%**	**36%**					
A	**9**	**10**	**32%**	**36%**		15	20	53%	72%
D	**8**	**6**	**29%**	**21%**		9	6	33%	21%
SD	**1**	**0**	**4%**	**0%**					
NC	**4**	**2**	**14%**	**7%**		4	2	14%	7%
DQ	**0**	**0**	**0%**	**0%**		0	0	0%	0%
Total	**28**	**28**	**100%**	**100%**		**28**	**28**	**100%**	**100%**

An analysis of the responses to the Phase Three survey revealed an interesting trend. The majority in agreement increased by a total of five respondents or roughly 20% of the sample (i.e. from 15 out of 28 to 20 out of 28). While the South respondents remained relatively stable when compared to Phase Two, the Winnipeg respondents exhibited a notable change (i.e. from 6 in agreement and 6 in disagreement to 11 in agreement and 2 in disagreement). Thus, while a contributing factor may have been fewer 'no comment' responses, the overall change in position mainly resulted from

Winnipeg respondents moving from disagreement to agreement. For the purposes of comparison totalled responses for both Phases Two and Three can be viewed in Table 16.

In order to comprehend reasons for the change in position, with the research team, I reviewed and analyzed each of the comments provided by Winnipeg respondents in response to the summary response statements on the Phase Three survey. Based on the content of the comments, it was concluded that no new reasons were provided that could account for the change in position with respect to the original statement. The comments reiterated and supported the original positions from the Phase Two survey.

Similar to Phase Two results, a number of Winnipeg respondents commented that Floodway expansion is needed in order to provide them with a sense of security.

> *I have built a 1997+2 feet dike and hope this is okay, but it will need a bigger floodway, and that is really, really needed – if we don't, then all [of] Winnipeg will flood.* [Winnipeg respondent #15]

While the majority of respondents are in agreement that flood protection beyond 1997+2 levels is required, the way to go about providing such protection varies based on geographic location. In order to achieve a greater sense of security many Winnipeg respondents feel an expanded Floodway is the most viable option. Many South respondents are more inclined to adopt personal flood protection above 1997+2 feet because they have to manage risk on an individual level and not on a collective level.

One comment expressed by a respondent in disagreement with the original statement reflected a sentiment that was raised by a number of Winnipeg respondents during the Phase One interviews, but not during the Phase Two survey.

> *In my neighbourhood, I don't (we don't) want the level of protection so high/extreme that it will destroy our community – e.g. huge dykes through our yards!* [Winnipeg respondent #10]

Many Winnipeg respondents indicated that while they desired increased flood protection, they were not willing to trade off personal values such as aesthetics, property values, and lifestyle convenience in order to accommodate the added protection. This relates to the situation discussed earlier in this section where one neighbourhood turned down enhanced flood protection after the 1997 flood despite the fact that some homes required it. The outcome of such inaction is that more homes are potentially vulnerable because some residents do not perceive flooding to be a serious or noteworthy threat.

Building on this notion that some Winnipeg respondents do not perceive the flood threat to be serious or worth inconveniencing one's lifestyle, one comment provided on the Phase Three survey offers a possible reason for such an attenuated perception of risk.

> *Dikes, etc. give a false sense of security. Once the water goes over the top, where is your security?* [South respondent #09]

This suggestion of a false sense of security was also identified as an issue during the Phase One interviews and will be addressed in the next section.

4.2.7 – False Sense of Security

The topic for this section builds on one of the notions identified in the previous section on flood protection measures. During the Phase One interviews, a number of Winnipeg respondents expressed a high level of confidence in the Floodway and stated that they felt quite safe from flooding due to its existence. Some Winnipeg respondents discussed conscious decisions on their part and on those of their neighbours to turn down enhanced personal flood protection for their home and neighbourhood based on this confidence in the Floodway. While in some cases reliance on the Floodway was not the sole reason for turning down enhanced flood protection (other reasons included aesthetics, personal cost-benefit, property values, lifestyle convenience, etc.), it was one

of the key factors that contributed to the decision. Based on these findings, the following statement was formulated and utilized on the Phase Two survey.

> *Due to the existence of the Floodway, some Winnipeg residents have a false sense of security, which results in inaction for most individuals from taking flood protection measures.*

The results with respect to the above statement are detailed below in Table 17.

Table 17: Delphi Phase Two – False Sense of Security

Flood Area Residents' Responses to Question #10									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	1	7%	3	21%	4	14%			
A	6	43%	4	29%	10	36%		14	50%
D	5	36%	3	21%	8	29%		9	32%
SD	1	7%	0	0%	1	3%			
NC	1	7%	4	29%	5	18%		5	18%
DQ	0	0%	0	0%	0	0%		0	0%
Total	14	100%	14	100%	28	100%			

While a small majority of respondents expressed agreement with the statement (i.e. 14 out of 28), there was a divergence between Winnipeg respondents and South respondents. South respondents were decidedly in agreement (i.e. 7 in agreement and 3 in disagreement), whereas Winnipeg respondents were divided (i.e. 7 in agreement and 6 in disagreement). Of note in the South respondent sample is the high percentage of 'no comment' responses (i.e. 4 out of 14). This may stem from the nature of the statement, as it pertains primarily to Winnipeg respondents; some South respondents felt that they did not have enough information to make an informed response.

The basis for divergence between South respondents and Winnipeg respondents became clear upon reviewing the reasoning provided for agreement or disagreement. South respondents in agreement with the statement provided similar reasoning.

> *Many Winnipeg citizens were unaware that a flood was occurring [in 1997].* [South respondent #03]

City of Winnipeg residents have an unreal outlook about floods and city officials spend more money (reimbursed by federal and provincial governments) helping non-compliant residents than is ever spent on compliant residents outside the floodway. [South respondent #06]

Large numbers of residents don't even realize they are in the floodplain. [South respondent #08]

1966 flood protection was not maintained. [The] City relies on [the] floodway and flooding homeowners south of the floodway. [South respondent #10]

Comments such as those above clearly indicate that an element of contention exists between urban and rural residents with respect to flood-related issues. One of the primary factors contributing to this contentious situation is the existence of the Floodway. Many South respondents perceive that a lack of awareness regarding flooding exists within Winnipeg due to the benefits provided by the Floodway. This issue has received much attention since the 1997 flood and has been raised at numerous public meetings on flood-related issues. While there are more factors involved in the existence of friction between Winnipeg and surrounding rural municipalities, the Floodway issue has been a key factor that has contributed to this situation.

Reasoning provided by South respondents readily exemplifies this as a variation between their rural state of mind from that of an urban mindset. A perception exists among some South respondents that many Winnipeg residents are unaware of flood risk and have a false sense of security due the Floodway. Based on the tone of the reasoning provided, it seems as though some South respondents harbour a considerable amount of resentment towards Winnipeg in general. This is expected given that post-1997 flood reports (e.g. MWC, 1998; IJC, 2000b) concluded that operation of the Floodway caused artificial flooding upstream of the Floodway Inlet. Many South respondents feel they

have been sacrificed to save Winnipeg and have not been recognized for this sacrifice. In the context of flood management this is an issue that has not been dealt with and will remain problematic until it is adequately addressed. All South respondents did not express these feelings of contention with respect to Winnipeg, as some disagreed with the statement. Unfortunately, the respondents did not specify their reasons for disagreement.

Since the original statement was primarily relevant to Winnipeg respondents, the bulk of this section focuses on their reasoning. As discussed earlier, many Winnipeg respondents' refused to adopt enhanced flood protection and some of the respondents who denoted agreement with the statement addressed this issue in their reasoning.

> *But it also reflects our resistance to messing up our properties through more doubtful local floodproofing solutions.* [Winnipeg respondent #10]

In cases such as the one above, a number of respondents expressed that while they do feel the Floodway will protect them regardless of what happens other factors were involved in decisions to turn down improved flood protection (e.g. aesthetics, perceived property values). For some respondents the sense of security afforded by the Floodway was one of the key factors in their decision to veto further flood protection, but not the sole reason.

In other instances, it was sole reliance on the Floodway that influenced some respondents to reject enhanced flood protection on a personal and neighbourhood level.

> *I and many of my neighbours voted against a backyard dike after the 1997 flood because we're inside the Red River Floodway. Besides it's going to be expanded in the near future.* [Winnipeg respondent #08]

The latter part of the above statement that makes reference to an expanded Floodway introduces an important consideration for decision makers. It appears that the current dependency and false sense of security provided by the Floodway may be compounded and exacerbated when the Floodway is expanded. An enhanced false sense of security

may contribute to the perception that Winnipeg is 'floodproofed' and has 'zero-risk.' This is not realistic and may create an increasingly complacent population that is more vulnerable because they may not perceive the flood threat nor take preventive action.

Other Winnipeg respondents also noted agreement, but in their reasoning made reference to Winnipeg residents living in areas protected by the primary dikes (the majority of the City). These respondents stated that those residents living on the riverside of the primary dikes are aware of the flood threat and it is the residents living behind the primary dikes that exhibit a false sense of security.

> *Only those in possible danger take an interest. In 1997 (and earlier) people in MOST of Winnipeg were not at all afraid. Also, "most" Winnipeg residents are not in any danger.* [Winnipeg respondent #02]

> *All people outside of the primary dikes know the risks thoroughly. Residents inside the primary dikes probably do have some false sense of security, which must be corrected by providing the security they believe they have.* [Winnipeg respondent #06]

Interestingly, both of the above respondents implied that for most City residents there is no danger from flooding or the element of danger could be eliminated through management. Though in 1997 there was a significant threat to the City and if the Brunkild Z-Dike had not been successfully constructed, the City could have flooded from the west via the La Salle River. In such a scenario, due to the high level of danger, the City had emergency plans in place that would have evacuated 125,000 City residents (McNeil, 2000). An unfortunate product of successful mitigation is the complacency that it creates. Without having experienced the worst-case scenario it appears that the above respondents have a false sense of security and are underestimating the objective risk.

For other respondents, the 1997 flood experience served as a signal event that made them re-evaluate their sense of security.

Until 1997 I felt quite secure due to the Floodway. No more. [Winnipeg respondent #07]

Statement true prior to 1997 flood. Less so today. [Winnipeg respondent #14]

Additionally, reasoning provided by other Winnipeg respondents who disagreed with the statement illustrated that not all respondents have been lulled into a false sense of security and some have an awareness of the flood threat.

I don't know of anyone who did not take the threat seriously. There is always the added concern that the Floodway gates could fail. [Winnipeg respondent #09]

We know from experience that despite the floodway we can be in deep water. When the expansion is completed complacency might arise. [Winnipeg respondent #12]

All river people know the problems of living by the water. The floodway is only as good as it's being improved and kept in good working order. [Winnipeg respondent #13]

Interestingly, one respondent who perceived flood risk and did not exhibit a false sense of security pointed out that complacency might accompany expansion of the Floodway. This could be a negative outcome of the expansion project if residents who were previously aware of flood risk become complacent and develop a false sense of security.

Overall, while a false sense of security does exist among some Winnipeg respondents, a range of perceptions were presented. A number of South respondents perceived that many City residents rely on the Floodway and are unaware of flood risk. Some Winnipeg respondents held similar perceptions but noted that it was other City residents that exhibit the false sense of security and not themselves. Several other Winnipeg respondents noted that the safety provided by the Floodway is sufficient enough to warrant turning down enhanced flood protection. Lastly, a few Winnipeg respondents were well aware of flood risk and noted that the protection provided by the Floodway is not absolute and that it could be overtopped.

4.2.8 – Evacuation Procedure and Management

A contentious issue during the 1997 flood was the enforcement of a mandatory evacuation order for high-risk areas of the basin. During the Phase One interviews, this issue was brought up by a number of respondents and for some this was the most heated topic of discussion about the 1997 flood and still upsets them more than six years later.

Similar to the last section, which was mainly applicable to Winnipeg respondents, the issue in this section was mainly applicable to South respondents. In 1997 the mandatory evacuation in southern Manitoba was carried out primarily to prevent the loss of lives. One consequence of this evacuation was that no one was left behind to monitor pumps and maintain temporary dikes; some respondents attributed the flooding of their homes to this evacuation order. Many South respondents who complied with the evacuation order and lost their homes to floodwaters perceived that residents who defied the order and remained behind were better off because they were able to save their homes. As such, these respondents indicated that in future flood events they would not evacuate and would instead stay behind to battle floodwaters and try to save their homes.

On the other hand, while some Winnipeg respondents were evacuated (only high-risk areas in the City were evacuated in 1997 and not all of the study respondents lived in these areas) their situation was different because City workers and community members were authorized to patrol temporary dikes in order to spot leaks or weaknesses. Even though the respondents were evacuated, they had the piece of mind that the workers and volunteers were monitoring their homes and neighbourhoods. Based on the Phase One interviews, the following statement was formulated for the Phase Two survey.

> *Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages, while some of those who defied the evacuation order*

were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.

Based on the above statement, respondents provided the results noted in Table 18.

Table 18: Delphi Phase Two – Evacuation Procedure and Management

Flood Area Residents' Responses to Question #17									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	0	0%	9	65%	9	32%			
A	8	58%	3	21%	11	39%		20	71%
D	3	21%	0	0%	3	11%		3	11%
SD	0	0%	0	0%	0	0%			
NC	3	21%	2	14%	5	18%		5	18%
DQ	0	0%	0	0%	0	0%		0	0%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

The majority of respondents agreed (i.e. 20 out of 28) that if there were a blanket mandatory evacuation order in the next flood, they would defy it in order to save their homes. Once again there was a notable difference in positions taken by the respondents. A strong majority of South respondents (i.e. 12 out of 14) agreed with the statement, while a weaker majority of Winnipeg respondents (i.e. 8 out of 14) were in agreement. Further, all eight of the Winnipeg respondents 'agreed' with the statement, while nine of the twelve South respondents 'strongly agreed' with the statement. In all likelihood, these results are a consequence of the context noted above (i.e. the 1997 experience).

The number of 'no comment' responses was somewhat high (i.e. 5 out of 28), which may be due to reluctance on the part of some respondents to have their potential evacuation behaviour put into writing for fear of it being used against them at a later date (even though respondents were assured that no personal references would be used). This was not surprising given that in the Phase One interviews some respondents were reluctant to come out and state that they would defy an evacuation order and were uncomfortable 'officially' committing to such an action (although, many affirmed this

preference 'off the record'). A contributing factor may be that some respondents recalled dealings with government officials in 1997 where they were told that if they defied an evacuation order they would not be eligible to receive compensation.

The primary reasoning provided by South respondents for strongly agreeing with the statement surrounded experience and preparedness on the part of the resident.

> *Persons with sufficient safety plans and equipment should be left to use their own judgement. Many people have successfully protected properties in seemingly hopeless situations.* [South respondent #06]

> *No one else can help you save your home or property and if you have the means and equipment, government should encourage [you] to do that.* [South respondent #07]

> *Most people who live nearby the Red River have seen, heard, or lived through one or two floods. They know when it is too dangerous to stay on their property and when to evacuate.* [South respondent #13]

> *We complied with the order – we had a generator to provide power for pumps should the Hydro be interrupted (which did happen) and no one was there to start the generator. The water came through the dike (seepage) there was no breach of the dike. This house could have been saved were someone there.* [South respondent #09]

These respondents have indicated the willingness to trade off the danger of being trapped in their home by a dike breach in order to remain behind and operate pumps and monitor their dike. Many South respondents expressed regret that they complied with the evacuation order in 1997 because they feel that had they remained in their homes they may have been able to save them. Also, the respondents expressed that they are not helpless, foolhardy people who will put their lives in danger; many have lived in the region and experienced numerous floods. Consequently, many felt that if they have preparedness plans and equipment (e.g. emergency escape route, sturdy boat with a working motor, food, clean water, cell phone, etc.) in place prior to the event they should be allowed to remain behind. Additional reasoning from South respondents included:

I would stay because of better access road and preparedness. [South respondent #10]

We are not leaving unless it is completely lost. [South respondent #02]

I will not leave next time. I could drive to and from my property with a passenger vehicle the entire flood, yet I had to leave. [South respondent #14]

People will be driven by emotion and adrenalin. They will choose what is best for them. [South respondent #11]

These comments suggest that some South residents are likely to defy an evacuation order in future floods due to their experiences during the 1997 flood. While the mandate of the responsible authorities is to first prevent the loss of life and then to protect property, the desire for residents is to save their property. Both sides need to work together to arrive at an amicable solution that addresses the needs of both parties.

Similarly, some Winnipeg respondents agreed with the statement on the basis that protecting one's property is an important part of flood response.

Protection of personal property (equals years of hard work, etc.) is a high priority. [Winnipeg respondent #10]

You must have access to your home. [Winnipeg respondent #05]

Property owners who have so much tied up in their property will always be prepared to defy authority if they believe they can save their property against the wishes of an uncaring government. [Winnipeg respondent #14]

Conversely, some South respondents expressed that evacuation orders should not be defied, but they should be planned in a way that vulnerable populations (e.g. elderly, children, and disabled) are evacuated first and then residents are given every reasonable chance to save their homes. Some respondents stated that an area-by-area evacuation policy might be more effective, as they questioned the effectiveness of a blanket order. Other respondents cited examples from 1997 where areas were evacuated long before floodwaters posed a threat and as such, valuable preparation time was lost.

Province-wide evacuation order would be ridiculous – must be area determined. [South respondent #15]

Evacuation order[s] should not be defied – I personally know of older couples 80 and up years old who live on the farm. If there is a great chance of flooding these people should be asked to leave – younger people could put their lives in danger trying to rescue these people in case of an emergency. [South respondent #08]

Based on the reasoning generated, the relative importance of the information to the scope of the study, and the potential implications for decision makers and responsible authorities, this statement was carried forth onto the Phase Three survey. The results from Phase Three of the Delphi Process are noted below in Table 19.

Table 19: Delphi Phase Three – Evacuation Procedure and Management

Flood Area Residents' Responses to Question #7									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	5	36%	7	50%	**12**	**43%**			
A	5	36%	7	50%	**12**	**43%**		24	86%
D	3	21%	0	0%	**3**	**11%**		3	11%
SD	0	0%	0	0%	**0**	**0%**			
NC	0	0%	0	0%	**0**	**0%**		0	0%
DQ	1	7%	0	0%	**1**	**3%**		1	3%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

Table 20: Phase Two and Three Comparison – Evacuation Procedure and Management

Flood Area Residents' Responses – Phase Two Question #16 & Phase Three Question #7								
	Total P2	Total P3	Percent P2	Percent P3	Total	Total	Total	Total
SA	**9**	**12**	**32%**	**43%**	A/D P2	A/D P3	Percent P2	Percent P3
A	**11**	**12**	**39%**	**43%**	20	24	71%	86%
D	**3**	**3**	**11%**	**11%**	3	3	11%	11%
SD	**0**	**0**	**0%**	**0%**				
NC	**5**	**0**	**18%**	**0%**	5	0	18%	0%
DQ	**0**	**1**	**0%**	**3%**	0	1	0%	3%
Total	**28**	**28**	**100%**	**100%**	**28**	**28**	**100%**	**100%**

There were no major changes in position from the Phase Two survey to the Phase Three survey. Once again the total number of 'no comment' responses declined (i.e. from 5 to 1) and in this case it appears that these respondents chose to select a position

and align with the majority (i.e. agreement with the original statement). The total number of Winnipeg respondents in agreement increased slightly (i.e. to 10 out of 14 from 8 out of 14), as did the total number of South respondents (i.e. to 14 out of 14 from 12 out of 14). Table 20 provides a comparison of the totals for Phase Two and Phase Three.

Overall, there were no new insights generated by the Phase Three survey. Following a thorough review of the comments provided in response to the summary response statements, it was noted that most of the respondents reiterated and verified their original positions from the Phase Two survey. For instance, many respondents felt that homeowners should be allowed to remain behind to protect their property given the right circumstances. In some cases the comments were more concise in Phase Three.

> *I will not leave in a future event. In doing so, will minimize my loss, as well as minimize the work in repairing damages.* [South respondent #09]

> *As long as they have safety plans, equipment, supplies, etc. they should be able to use their own judgement.* [South respondent #08]

> *Generally, people have a sense of their capability and vulnerability. If they have a plan of 'escape' in an emergency they should be allowed to stay on their property to protect it.* [Winnipeg respondent #10]

> *Most people have already had experience with flooding before the 1997 flood. They usually are better at deciding what's best for their property and situation during flooding.* [South respondent #13]

The last comment verifies that residents who have experienced past flood events desire control over their personal situation and feel that they are better able to deal with their personal situation. Since residents are responsible for their own homes, they want to have the authority and control over their ability to save or lose their home. A mandatory evacuation is contentious because it removes authority and control and inhibits the homeowners' ability to protect their possessions. Many of the study respondents stated

that it is their responsibility to protect and save their homes because no one else will do it for them. As such, they feel that evacuation should be their personal choice or at the least they should be involved in the development of the evacuation policies that will affect them. Mandatory evacuation is viewed as an attempt by government to take control and remove the authority from the residents over their own property. One respondent noted that an indemnity clause may be a solution; if the government removes the authority from residents then they must also take the responsibility because these go hand-in-hand.

4.2.9 – Visual Presentation of the Flood

The situation that occurred in Grand Forks, North Dakota during the 1997 flood was one of extreme devastation. Not only did the town dikes breach, inundating the majority of the town, a large fire broke out in the downtown business district that fire crews were unable to properly fight because the town was under water. The disaster was captured vividly in both the print and television news media and this incident served as a signal event that encapsulated the magnitude of the 1997 flood disaster.

During the Phase One interviews a number of respondents specified that a major source for flood-related information was the news media. One of the benefits for Manitobans living downstream along the Red River is the ability to watch and read media reports about occurrences upstream as a precursor for what can be expected to arrive downstream a short time later. Many Winnipeg and South respondents stated that one of the key events that influenced their perceptions of flood risk during the 1997 event was watching and reading about the disaster that unfolded in Grand Forks. These respondents cited viewing the occurrence of this event as the time at which they realized the seriousness of the situation. For some respondents this event also influenced them to

seek out more information and to undertake preventive measures. Based on these findings, the following statement was included on the Phase Two survey.

> *Seeing the flood situation in Grand Forks on TV in 1997 demonstrated the seriousness of the flood situation and influenced me to undertake preventive actions (e.g. move belongings out of the basement, start to sandbag, etc.).*

A breakdown of the responses to the above statement can be noted below in Table 21.

Table 21: Delphi Phase Two – Visual Presentation of the Flood

Flood Area Residents' Responses to Question #18									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	4	29%	4	29%	8	29%			
A	2	14%	6	42%	8	29%		16	58%
D	4	29%	4	29%	8	29%		10	36%
SD	2	14%	0	0%	2	7%			
NC	1	7%	0	0%	1	3%		1	3%
DQ	1	7%	0	0%	1	3%		1	3%
Total	**14**	**100%**	**14**	**100%**	**28**	**100%**		**28**	**100%**

While the majority of respondents agreed with the statement (i.e. 16 out of 28), a significant portion also disagreed (i.e. 10 out of 28). Once again the geographic diversity in perceptions was prevalent as Winnipeg respondents were divided on the issue (i.e. 6 in agreement and 6 in disagreement) and South respondents were more in agreement (i.e. 10 in agreement and 4 in disagreement). The reasoning provided on the Phase Two survey indicated that for many of the respondents who agreed with the statement, the visual presentation of the flood played an important role in their perception of the threat.

> *This was very convincing [and] we saw that the situation was serious. It gave us time to save some of our belongings and build the dike.* [South respondent #01]

> *When I saw the crisis in Grand Forks I knew that this water could not go elsewhere but come our way. So with the help of families and friends we were more prepared.* [South respondent #08]

> *When I saw what was happening in Grand Forks I started my flood preparations.* [South respondent #14]

It was common sense to get started organizing. I.e. booking a mover for big furniture. [Winnipeg respondent #03]

While one cannot directly attribute the response behaviour of the respondents in 1997 to viewing the Grand Forks situation, the incident did serve as a signal event that convinced many of the respondents of the seriousness of the situation and may have influenced the timing of their preparations. In an emergency timing is critical and any means that can convince residents to prepare early will help to reduce potential impacts.

Alternatively, the reasoning provided by those respondents who disagreed with the statement addressed a number of issues. The first notable issue related to response behaviour, as some respondents expressed that it was not the Grand Forks situation that influenced their actions. Instead, these respondents stated that it was recommendations from institutional sources that were the determining factors in their response behaviour.

We were told not to worry from water resources and we acted too late by the time we found out we were misinformed. [South respondent #03]

Prior to the event I checked with the forecasters office in Niverville. I was told "do not move anything. You are not getting flooded. You are 2 feet above the 100 year level ... If it will make you feel any better, then you can make a row of sandbags around the house, but they are not getting wet, you won't get any water." I trusted that information and found that decision to be a mistake. [South respondent #09]

Similarly, other respondents expressed that it was not the Grand Forks situation that influenced their response behaviour; instead, factors such as personal risk assessments based on experience, local forecasts, and weather were the influences.

We took preventive actions when it was deemed necessary here – not because of Grand Forks. [Winnipeg respondent #02]

I didn't undertake preventive action until local forecasts indicated the potential for serious problems. [Winnipeg respondent #14]

We [had] already moved stuff [and] started sandbagging, etc. Once city staff were here to teach us how to sandbag we started. [Winnipeg respondent #13]

Hindsight is always a great teacher and the Grand Forks situation in future would influence some of our decisions, it was the April 7 snowstorm that was the determining factor of a major flood. [South respondent #15]

Three Winnipeg respondents explicitly mentioned that their perceptions and subsequent behaviour were directly related to local forecasts for the City. For these respondents, their personal assessment of risk was influenced more by expert prediction than it was by visual presentation of the flood through the media. This illustrates the importance of flood forecasting and its role in residents' perceptions of flood risk.

For some of the other respondents personal preparedness was based on auxiliary factors such as past experience and awareness of flood indicators such as the amount of winter snowfall and the April 1997 blizzard. This was also a common finding during the Phase One interview process. Many South respondents noted that based on the substantial amount of snow on their property and similar musings from truck drivers regarding snowfall amounts in North Dakota, they knew by mid-January that a serious flood would occur that year. One respondent noted that for her family an indicator of the potential for serious spring flooding was the unusual amount of 'snow days' that had kept her children home from school. While subjective in nature, these means for assessing the potential flood threat were essential determinants in the respondents' perceptions of flood risk and subsequent preparedness behaviour.

In accordance with the divergence in positions, the variety of responses generated, and the importance of the issue to the scope of the study, the original statement was carried forward onto the Phase Three survey. The results from Phase Three (noted in Table 22) showed some slight variation in comparison to the results from Phase Two as the sample shifted to a stronger majority (i.e. from 16 of 28 in agreement to 20 of 28 in

agreement). The reason for the stronger majority in agreement stems from a shift in position among Winnipeg respondents. In Phase Two Winnipeg respondents were divided on the issue (i.e. 6 in agreement and 6 in disagreement), but in Phase Three they were decidedly more in agreement (i.e. 10 in agreement and 4 in disagreement).

Based on the change in position it appears that reading the summary response statements may have influenced some respondents to reflect and reconsider their original positions. Also, respondents that had 'no comment' and were 'disqualified' in Phase Two provided responses in Phase Three. Comments provided in response to the summary response statements in Phase Three did not generate any new information or add any value to the study. Once again the respondent's original positions and reasoning were validated. Responses from Phases Two and Three are compared in Table 23.

Table 22: Delphi Phase Three – Visual Presentation of the Flood

Flood Area Residents' Responses to Question #8									
	WG	WG %	S	S %	Total	Percentage		Total A / D	Total Percent
SA	6	43%	2	14%	8	29%			
A	4	29%	8	57%	12	43%		20	71%
D	3	21%	3	21%	6	21%		8	29%
SD	1	7%	1	7%	2	7%			
NC	0	0%	0	0%	0	0%		0	0%
DQ	0	0%	0	0%	0	0%		0	0%
Total	14	100%	14	100%	28	100%		28	100%

Table 23: Phase Two and Three Comparison – Visual Presentation of the Flood

Flood Area Residents' Responses – Phase Two Question #18 & Phase Three Question #8								
	Total P2	Total P3	Percent P2	Percent P3	Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	8	8	29%	29%				
A	8	12	29%	43%	16	20	58%	71%
D	8	6	29%	21%	10	8	36%	29%
SD	2	2	7%	7%				
NC	1	0	3%	0%	1	0	3%	0%
DQ	1	0	3%	0%	1	0	3%	0%
Total	28	28	100%	100%	28	28	100%	100%

Overall, it appears that for some respondents the visual presentation of the flood had a significant influence on their perceptions of risk in 1997. For a number of respondents, watching the disaster unfold in Grand Forks allowed them to personalize the threat and convinced them of the seriousness of the situation. In some cases, these respondents noted that the Grand Forks situation also influenced their behaviour as they commenced preventive actions based in part on the disaster images. Other respondents did not view the Grand Forks situation in the same manner; these respondents noted that local forecasts from experts and other personal risk assessment measures based on past experience were essential to their perceptions of flood risk and preventive behaviour.

4.3 – Institutional Representatives

In addition to examining residents' perceptions of flood risk, another objective of this study was to examine the perceptions of the organizations responsible for hazard and disaster management in the Red River Basin. In order gain an understanding of these perceptions, key personnel (Institutional Representatives) from pertinent organizations were involved. As stated previously, in order to make robust management decisions that reduce vulnerability and foster sustainability, decision makers must have an awareness of local residents' perceptions of risk. The goal of this component of the research was to investigate issues and perceptions from an institutional perspective so as to provide a comparison with the data on risk perception generated from the Flood Area Residents.

The same research methods used with Flood Area Residents were applied during Phase One of the Delphi Process with Institutional Representatives. Due to busy work schedules, the interviews with Institutional Representatives were shorter in duration and as such, did not generate the same quantity of data as the Flood Area Resident interviews.

The quality of data was not compromised, as the interview subjects were all experienced and well articulated with respect to hazard and disaster management and discussed various issues in detail. These issues were formulated into statements that were then presented to participants on the Phase Two survey, where they selected Likert scale positions and provided written reasoning. The Phase Three survey allowed participants to provide additional comments with respect to the issues and also verified original positions. The following seven sub-sections present the results from Phase One and detail the results that were subsequently derived from Phase Two. Of these seven issues, four were deemed pertinent and carried forth for further analysis in Phase Three. The results from this final analysis are also presented where applicable.

4.3.1 – Priority of Disaster Issues

The first issue noted during Phase One dealt with the perception of complacency. A number of respondents stated that since there are often large gaps of time between high magnitude flood events, the public and political bodies tend to lose interest as more time passes after a significant event. One consequence of this decreased interest in floods on the public agenda is that government organizations tasked with hazard and disaster management often have required resources reduced (i.e. finances, programs, logistics, personnel, etc.). The respondents indicated that this issue is not strictly isolated to flood disasters, but is applicable in an all-hazards context; immediately after an event there is a peak in interest and resources for a few years before a decline and complacency sets in. The post-event period represents a brief window of opportunity to implement programs and policies that address risk and vulnerability. Based on the relevance of this issue to the study, the following statement was included on the Phase Two survey.

Disaster issues do not maintain a high priority in public perceptions and on political agendas because of their infrequent occurrence, resulting in reduced resource allocation over time.

Responses to the above statement are detailed in Table 24. *The present study is not representative of all institutional experts in the Red River Basin and the numeric values in the proceeding tables are not intended to be interpreted as samples to represent all institutional experts. The tables and their numeric content were utilized to draw an understanding and recognition of patterns within the sample and no attempts were made to infer about the larger population based on these numbers. Within all tables, the following notations were used: SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree, NC = No Comment, DQ = Disqualified, SG = Senior Government, LG = Local Government, NG = Non-Government. The numeric ordering of the questions is not sequential because the surveys were part of the broader risk management module.*

Table 24: Delphi Phase Two – Priority of Disaster Issues

Institutional Representatives' Responses to Question #5								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	3	2	0	5	50%			
A	2	0	2	4	40%		9	90%
D	0	1	0	1	10%		1	10%
SD	0	0	0	0	0%			
NC	0	0	0	0	0%		0	0%
DQ	0	0	0	0	0%		0	0%
Total	5	3	2	10	100%		10	100%

The majority of respondents were in agreement with the statement (i.e. 9 out of 10) and indicated that since disaster issues do not maintain a high priority over time a decrease in resources results. In accordance with the high level of agreement, there was no divergence between the different categories of Institutional Representatives. The only respondent that noted disagreement was a lone local government representative.

Much of the reasoning provided by the respondents reiterated their sentiments from the Phase One interviews and detailed the context of the issue.

> *There has been plenty of evidence of this. Emergency staff have been reduced, data networks severely cut, etc. following periods without floods. This has lead to real difficulties and poor preparedness for disasters.* [Institutional respondent #03]

> *Emergency management resources are looked at as an expense when they are not being used. Emergency management is also not yet recognized as a profession, most people think that anyone could do it and could be assigned when needed.* [Institutional respondent #04]

> *The "out of sight out of mind" happens and disaster preparedness is allowed to erode to a dangerous low level.* [Institutional respondent #08]

The above reasoning clearly exemplifies the difficulties faced by emergency managers. From a hazard and disaster management standpoint the recognition and reality of flood risk endures, along with the need for resources, during non-flood times. Yet, from a political standpoint unless there is an imminent flood threat the allocation of resources is not a foremost priority, despite the ongoing existence of flood risk. In addition, unless there is a public outcry or demand for emergency management resources during non-disaster times, the issue easily falls off the political agenda and becomes a prime candidate for cost-saving cutbacks. The problem herein is that when the public does not perceive risk or chooses to ignore it, so to do the political decision makers.

Another respondent provided a similar case, but expressed a more detailed reason that addressed the issue of local residents' perceptions.

> *This is a corner stone of the dilemma that emergency managers have. The infrequent Red River floods and equally important, success in mitigating impacts, whether by design or straight luck also reduces the perceptive profile of the flood risk. An example is that in 1997, we got away with a number of very lucky acts of God, which mitigated significant tragedies. But in doing so supported the perception that we can beat the risk or worse, [that] the risk projectors were wrong, and the local perceptions were correct. Thus much of the municipalities and residents have the "validated" perception of the province overpowering them and issuing perceptively*

> *draconian directives [that] were unwarranted. Thus our "luck" to date of not loosing a town, having a dangerous goods incident go bad in a community, etc. feeds the perception that the threat is not as bad as risk managers perceive. In a competitive environment for dollars and political support this is a critical limitation of the success of the disaster management programs for funds and resources.* [Institutional respondent #06]

The above comment is noteworthy as the respondent feels that the success of mitigating the impacts of the 1997 flood may have negatively influenced disaster management by causing attenuation in perceptions of risk at the local level. While the 1997 flood was a major disaster, the respondent rightly points out that the event could have been much worse. If a major rainfall had occurred and town dikes were overtopped, many more homes would have been flooded. If a dangerous good had contaminated the floodwaters the ripple effects could have been significant. The respondent is concerned that without experiencing a worst-case scenario, some residents will perceive that the 1997 experience was the worst-case and since it was successfully managed there is no need to worry about or prepare for future floods.

Based on personal experience, this last respondent has observed that attenuation in perceptions of risk is a contributing factor to the reason that disaster issues do not remain high on the list of public priorities. If the respondent's observations are correct and the perception at the local level is indeed that "we can beat the worst risk" and "the threat is not as bad as they tell us," then the result may be a population that is more vulnerable to larger floods because they are grossly underestimating the risk and may not be prepared. Unfortunately, for those who do not perceive the threat it may take a serious incident (e.g. a Grand Forks type situation in Manitoba) to convince them of the severity of the threat. As long as mitigation measures are successful and nature is managed, it becomes more difficult for emergency managers to convey the objective reality of risk.

While there are likely specific regions where the respondents' observations may be accurate (e.g. some residents within Winnipeg), based on the responses provided by the Flood Area Residents in this study, in most cases these attenuated perceptions do not exist. Many Flood Area Residents expressed the realization that 1997 could have been much worse under certain circumstances. Despite these findings, the tone of the above reasoning suggests that the psychosocial barrier between local citizens and emergency managers that developed during the 1997 flood (Haque, 2000) still remains; some emergency managers feel that local citizens do not properly perceive flood risk.

4.3.2 – Structural Mitigation Measures

As noted previously, in addition to utilizing issues raised by respondents during the Phase One interviews, a number of important concepts from the risk perception literature were relevant to the scope of the study. One such issue was the observation that some places are perceived to be risk-free due to the existence of structural mitigation measures. Various scholars have dealt with the subject (Dynes, 1970; Newton, 1996; Etkin, 1999; Mileti, 1999) and some have suggested that vulnerability is increased in places where the perception of being risk-free exists. Based on the literature, the following statement was formulated and included on the Phase Two survey.

Structural interventions generally create a perception that places are risk-free and may provide a false sense of security that leads to increased vulnerability.

A breakdown of the responses to the above statement is detailed in Table 25. The majority of respondents agreed with the statement (i.e. 7 out of 10) and supported the observation that structural measures tend to create a perception that places are risk-free, which can result in increased vulnerability. Senior government respondents mainly agreed with the statement (i.e. 4 agree and 1 disagree), local government respondents also

agreed (i.e. 2 agree), and non-government respondents were divided (i.e. 1 agree and 1 disagree). One local government respondent chose to have 'no comment.'

Table 25: Delphi Phase Two – Structural Mitigation Measures

Institutional Representatives' Responses to Question #6								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	2	1	0	3	30%			
A	2	1	1	4	40%		7	70%
D	1	0	1	2	20%		2	20%
SD	0	0	0	0	0%			
NC	0	1	0	1	10%		1	10%
DQ	0	0	0	0	0%		0	0%
Total	5	3	2	10	100%		10	100%

Reasoning provided by those in agreement supported the postulations outlined in the literature and indicated that such a limitation exists in the Red River Basin, where the primary focus for flood mitigation has been on structural measures and interventions.

> *We have to know the limits of the structures and also [take] that into account [with] the risk potential of possible disasters.* [Institutional respondent #08]

> *While structures can be very effective in reducing flood damages, they can be overtopped with serious consequences. People should always be told of the risks and limitations of the control works which affect them.* [Institutional respondent #03]

The above reasoning indicates that from an expert or institutional viewpoint an awareness of the limitations of structural flood control works exists. The issue being expressed is that not only do the physical limitations need to be accounted for in management practices, but these limitations also need to be clearly communicated to the public. When the limitations or weaknesses of structural measures are clearly explained to local residents, it allows them to become more informed and may lead to more accurate perceptions of risk. If residents are aware of the flood level they are protected to and understand that level may be exceeded, they will be better able to make personal decisions regarding further action on flood protection. Those who choose to heed the

information will be more resilient because they are likely to be better prepared in the event that floodwaters exceed the physical capacity of their protection measures.

The value of this issue lies in the ability of the responsible institutional organizations to communicate this knowledge to the public. One consequence of an uninformed population is that they are unlikely to be prepared to absorb changes as they occur; if a structural measure were to fail an uninformed public may panic or make poor decisions as a result. For instance, a number of Winnipeg respondents noted that during the 1997 flood their stress and anxiety increased when they heard the West Dike might fail and the City could flood from the west. In the southernmost areas of the City there was a scramble to quickly remove personal belongings from homes. If the risk had been assessed prior to the event this threat could have been communicated earlier and residents could have been better prepared. It is essential that threat levels are communicated to the public in a timely and efficient manner so that they are informed and aware. A lack of information often leads to uncertainty, which can ultimately result in public opposition making hazard and disaster management more difficult over both the short and long-term.

Another issue noted in the reasoning was the perception of a false sense of security that arises from the level of safety provided by structural measures.

> *The names of programs that have paid for structural works also add to this perception. Following the 1997 flood Canada/Manitoba provided $130 million under the "Flood Proofing Program" – the name itself implies risk free properties.* [Institutional respondent #04]

> *The success in the previous years of flooding gave a false perception that we had already handled the worst. That ring dikes could solve any flooding threat. However, real analysis shows that since 1950 we have been extremely lucky and the program of risk management by increasing mitigation dikes by adopting a last event plus 2 feet has always worked. While doubling the floodway may enhance the management of the threat to Winnipeg, we maybe under false illusion that what we*

have done in the valley by going 1997 plus 2 feet is good enough. [Institutional respondent #05]

While the first comment is essentially an issue of semantics, it remains an important issue with respect to communication to residents. By using the phrase 'floodproof' to describe post-1997 mitigation schemes, the respondent feels that some residents may take the protection at face value and assume that they are indeed floodproofed. However, as indicated by the Phase Two responses from Flood Area Residents, most perceive that floods larger than 1997 can occur and as such, do not feel they are floodproofed. From a communications standpoint, perhaps utilizing a different phrase that does not imply an absolute level of safety may be more effective (e.g. flood protection or flood prevention).

The second comment focuses on the actual delivery of the floodproofing program. The respondent expressed that the accepted practice of continually enhancing flood protection levels to reflect the largest flood experienced plus two feet of freeboard is insufficient. The respondent noted that while this management practice has been effective to date (i.e. after 1950 and 1979), there is no guarantee for rural residents that flood protection of 1997+2 feet will keep their homes dry and floodproof. Due to past success, the respondent feels that many residents may have a false sense of security and thus, may be more vulnerable. Again, based on the responses from Flood Area Residents this does not appear to be the case. Many respondents indicated that they do not feel safe at 1997+2 feet and for those who did not adopt higher protection many desire to do so.

4.3.3 – Variations in Perception

Another notable issue that exists in the literature is the belief that a gap exists between the objective-based perceptions of experts and the more subjective-based perceptions of laypeople (Cutter, 1993). During the Phase One interview process, it was

observed that noteworthy differences in perception existed between all of the different stakeholders involved. In order to ascertain whether there was recognition of these perceptual differences among the institutional organizations in the basin and whether they were being addressed, the following statement was posed on the Phase Two survey.

> *Differences in flood-risk perceptions that exist between all stakeholders (e.g. urban vs. rural residents, local vs. regional, professional vs. public) create gaps that complicate emergency and floodplain management. Floodplain and emergency management strategies should take into account these differing perceptions.*

A breakdown of the responses to the above statement can be noted in Table 26.

Table 26: Delphi Phase Two – Variations in Perception

Institutional Representatives' Responses to Question #8								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	2	0	2	20%			
A	4	0	1	5	50%		7	70%
D	1	0	1	2	20%		2	20%
SD	0	0	0	0	0%			
NC	0	1	0	1	10%		1	10%
DQ	0	0	0	0	0%		0	0%
Total	5	3	2	10	100%		10	100%

Reflecting the trend from previous statements, the majority of respondents agreed with the statement (i.e. 7 out of 10). Senior government respondents were largely in agreement (i.e. 4 out of 5), local government respondents were also in agreement (i.e. 2 out of 3 strongly agree), and non-government respondents were split on the issue (i.e. 1 agree and 1 disagree). One local government respondent provided 'no comment.'

For this particular statement the respondents did not provide any noteworthy or insightful reasoning as they had for the previous statements. This may be a reflection of the ambiguity of the statement, respondent lethargy, or a reflection that while respondents agreed with the statement they were unsure how to account for the differing perceptions.

> *I agree with this statement but have yet to see effective strategies that work. Differences are often voiced by individuals who have no logical argument or position, their main goal is to upset the process.* [Institutional representative #04]

The latter part of the above reason illustrates that the gap between experts and laypeople is quite prevalent in some instances. The respondent noted that some residents "have no logical argument or position, their main goal is to upset the process." While one cannot speculate as to the reasons for the actions of such individuals, obviously there are unresolved issues from the 1997 flood and perceptual differences that have been problematic for decision makers. Such divergence may be associated with these two sides working separately against each other, rather than collaboratively towards amicable solutions for all parties involved. Another reason may be that some residents faced with uncertainty may have turned to public opposition in order to "upset the process."

Another respondent reasoned that reductions in resources during non-flood times (discussed previously, see section 4.3.1) plays a role with respect to this issue statement.

> *It is very hard for those developing the strategies to take strong steps in this direction, while trying to manage the drain of resources in good times, the cutbacks and [the] need to meet the day-to-day dilemmas. As an example, within [our organization], a branch was formed to do just this, but we have had [many issues] added to the list of first priorities, with no increase in resources as the increase in threats materialize.* [Institutional respondent #05]

In order for institutional organizations to properly address existing gaps and to prevent the emergence of new ones, it is necessary to involve all stakeholders in the decision-making process. Nevertheless, to adequately involve all stakeholders takes a sufficient amount of time, planning, and resources. Unless the political will exists to provide these resources, the managing organizations are incapable of satisfactorily addressing the issue.

One respondent who supported the statement provided reasoning that offered a potential direction for organizations to move towards.

> *These gaps certainly exist and lead to confusion in flood plain management. It is not that easy to overcome these gaps but better information and communication is the way to go.* [Institutional respondent #03]

Once again the respondent noted that from an institutional perspective these gaps create problems and solutions are difficult to arrive at. While better information and communication may help reduce the gaps, the respondent failed to take the issue a step further and offer thoughts on potential solutions. As noted by prior respondents, the key to a solution lies in the allocation of resources. Any successful attempt at information dissemination and proper communication will require sufficient resources to meet the needs of all stakeholders involved, which may then help reduce gaps in perception.

Based on the importance of this issue to the scope of the study and the lack of substantive reasoning provided in Phase Two, the statement was carried forth into Phase Three. The expectation from a research perspective was that with another round and a chance to view the summary response statements, the respondents would provide more valuable comments. The results from the Phase Three survey are noted in Table 27.

Table 27: Delphi Phase Three – Variations in Perception

Institutional Representatives' Responses to Question #3								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	1	1	0	2	25%			
A	2	1	2	5	63%		7	88%
D	1	0	0	1	12%		1	12%
SD	0	0	0	0	0%			
NC	0	0	0	0	0%		0	0%
DQ	0	0	0	0	0%		0	0%
Total	**4**	**2**	**2**	**8**	**100%**		**8**	**100%**

There was no discernable change from Phase Two to Phase Three. The main difference was proportion as the sample size decreased due to dropouts, but the total number of respondents in agreement remained the same (i.e. in Phase Two 7 out of 10

agreed and in Phase Three 7 out of 8 agreed). As such, the percentage of respondents who agreed in Phase Three was higher than it was in Phase Two, indicating a stronger majority. Table 28 provides a comparison of Phase Two and Phase Three responses.

Table 28: Phase Two and Three Comparison – Variations in Perception

Institutional Representatives' Responses Phase Two Question #8 & Phase Three Question #3								
	Total P2	Total P3	Percent P2	Percent P3	Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	2	2	20%	25%				
A	5	5	50%	63%	7	7	70%	88%
D	2	1	20%	12%	2	1	20%	12%
SD	0	0	0%	0%				
NC	1	0	0%	0%	1	0	10%	0%
DQ	0	0	0%	0%	0	0	0%	0%
Total	10	8	100%	100%	10	8	100%	100%

The comments that were provided on the Phase Three survey supported the notion that education and communication were the operative solutions to address existing gaps. While the original statement was strongly supported, the respondents did not provide any comments that suggested the participating institutional organizations were working towards a solution. Reasoning detailed hindrances (i.e. lack of resources), possible solutions (i.e. information and education), and an acknowledgement that the issue creates difficulties for hazard and disaster management, but none of the organizations appear to be taking a lead and trying to address the gaps in perception that exist in the basin.

4.3.4 – Visual Presentation of the Flood

One of the issues raised by some Institutional Representatives during the Phase One interviews addressed a similar subject that had been raised by many Flood Area Residents. A number of Institutional Representatives recognized that watching the Grand Forks disaster unfold in the media had facilitated local residents' awareness of the flood

threat in 1997. Based on the importance of this issue to the scope of the study and due to the relevance of the reasoning provided by Flood Area Residents, a statement reflecting this issue was included on the Institutional Representatives' Phase Two survey. The principal intention was to examine institutional perceptions with respect to the visual presentation of the flood and then compare the findings with the perceptions of the Flood Area Residents. The following statement was included on the Phase Two survey.

> *To improve risk awareness, as well as emergency preparedness and response, more emphasis should be given to the visual presentation of extreme natural events (e.g. seeing Grand Forks on TV in 1997 verified the seriousness of the situation and prompted many to undertake preventive actions).*

Positions taken in response to the above statement are provided below in Table 29.

Table 29: Delphi Phase Two – Visual Presentation of the Flood

Institutional Representatives' Responses to Question #16								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	1	0	1	10%			
A	4	0	1	5	50%		6	60%
D	1	1	1	3	30%		4	40%
SD	0	1	0	1	10%			
NC	0	0	0	0	0%		0	0%
DQ	0	0	0	0	0%		0	0%
Total	**5**	**3**	**2**	**10**	**100%**		**10**	**100%**

Similar to the Flood Area Residents, this issue was one that Institutional Representatives were divided on. While the majority agreed with the statement, it was a small majority (i.e. 6 out of 10). Senior government respondents generally agreed with the statement (i.e. 4 agree and 1 disagree), local government respondents were more in disagreement (i.e. 1 agree and 2 disagree), and non-government respondents were divided (i.e. 1 agree and 1 disagree). The comments provided by the respondents clarified the reasons for divergence between those in agreement and those in disagreement. Similar to the reasoning of Flood Area Residents in agreement, Institutional Representatives in

agreement reasoned that viewing the Grand Forks situation ahead of time enabled local residents to grasp the gravity of the situation and afforded them time to prepare.

> *Grand Forks images gave MB residents time to prepare for the flood.* [Institutional respondent #10]

> *Such images bring home the reality of emergency situations and the need to act.* [Institutional respondent #04]

> *Pictures are worth thousands of words.* [Institutional respondent #07]

Any meaningful method that can effectively convey the seriousness of a situation and the potential flood threat is an important tool in an emergency. If the residents become more aware and are better prepared they stand a greater chance of getting through an event without incurring devastating losses (i.e. they are more resilient). While the Grand Forks disaster not only convinced Flood Area Residents of the seriousness of the situation, it may have also convinced some Institutional Representatives and others involved in Manitoba's flood response about the threat. Even though no two situations are identical, viewing the Grand Forks situation showed decision makers that the worst-case could happen and indicated that Manitoba needed to be prepared. In some instances it may be easier to convince people to prepare for the worst-case if a working example has occurred close to home; then the residents can personalize the threat and it can be visualized and easily retrieved from memory. It is often more difficult to convince people to prepare for a worst-case scenario if one has not previously occurred and they do not have a reference point from which to conceptualize their perceptions.

Institutional Representatives who disagreed with the statement expressed reluctance with the use of visual images to convey the seriousness of the flood threat.

> *Fear does not help in encouraging preparedness. It must be reasoned with the community.* [Institutional respondent #11]

Essential mitigation and flood preparedness is the necessity ... not scare tactics. [Institutional respondent #08]

This is somewhat dangerous and may cause unnecessary panic. When people saw Grand Forks go under they were extremely worried about the Valley towns and the City of Winnipeg, to no avail. People must be educated to trust the professionals in the business for information on the flood risk. [Institutional respondent #03]

Clearly, from an institutional perspective two different viewpoints with respect to the visual presentation of the flood have emerged in this study. One view embodies the perception that it aids preparedness and response by convincing local residents about the seriousness of the situation and the other perceives that it causes fear and unnecessary panic that does not aid the preparedness and response actions of local residents.

Based on the divergent viewpoints that arose during Phase Two, the relative closeness of positions, and relevance to the scope of the study, this statement was carried forth onto the Phase Three survey. The results from Phase Three are noted in Table 30.

Table 30: Delphi Phase Three – Visual Presentation of the Flood

Institutional Representatives' Responses to Question #8								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	0	0	**0**	**0%**			
A	2	1	2	**5**	**63%**		5	63%
D	1	1	0	**2**	**25%**		2	25%
SD	0	0	0	**0**	**0%**			
NC	1	0	0	**1**	**12%**		1	12%
DQ	0	0	0	**0**	**0%**		0	0%
Total	**4**	**2**	**2**	**8**	**100%**		**8**	**100%**

No significant adjustment in positions occurred on the Phase Three survey that would warrant detailed examination. The majority of respondents remained steadfast in agreement with the statement (i.e. 5 out of 8) and those in disagreement decreased in number (i.e. from 4 out of 10 to 2 out of 8). This may be a reflection of a decrease in the sample size (as noted earlier, two respondents dropped out reducing the total number of

participants from 10 to 8) and the fact that one respondent chose to provide 'no comment' in Phase Three. The number of senior government respondents in agreement decreased (i.e. from 4 out of 5 agree to 2 out of 4 agree), local government respondents became divided with one less respondent in disagreement (i.e. 1 agree and 1 disagree), and non-government respondents moved from being split to fully in agreement (i.e. 2 out of 2 agree). Table 31 provides further comparison of Phase Two and Phase Three.

Table 31: Phase Two and Three Comparison – Visual Presentation of the Flood

Institutional Representatives' Responses Phase Two Question #16 & Phase Three Question #8								
	Total P2	Total P3	Percent P2	Percent P3	Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	1	0	10%	0%				
A	5	5	50%	63%	6	5	60%	63%
D	3	2	30%	25%	4	2	40%	25%
SD	1	0	10%	0%				
NC	0	1	0%	12%	0	1	0%	12%
DQ	0	0	0%	0%	0	0	0%	0%
Total	10	8	100%	100%	10	8	100%	100%

Most of the comments provided in Phase Three did not contribute any added value to the study. Respondents who agreed either provided no comments or reiterated the notion that watching the Grand Forks disaster in 1997 was Manitoba's wakeup call with regard to the seriousness of the situation. Respondents who disagreed reaffirmed the opinion that visual presentation of the flood can cause fear and panic amongst the public. One respondent stated that further research is required to determine the potential effectiveness or limitations of using such methods (e.g. how many residents might panic). Two other respondents provided comments that were worthy of some further discussion. The first disagreed and provided reasoning that had not been mentioned in Phase Two.

> *Some people will only believe when it's staring at them. However ... what is happening somewhere else can be misleading. I would hope that people have enough confidence in the river forecast for their area so they don't need to make a judgement*

based on a visual of a problem elsewhere. When Grand Forks went under, many folks said we were all doomed. [The] fact is all our towns which had dikes fared very well and [the] Floodway protected Winnipeg. [Institutional respondent #03]

Some respondents feel that by visually presenting the flood other aspects of flood and emergency management may be deemed unnecessary or ignored. Clearly, sole reliance on visual presentation of the flood would not be prudent; rather, it would be beneficial to include visuals as part of a larger risk management and preparedness strategy. There are a number of variables that would be involved with such a strategy and each would operate in concert, not independently (e.g. flood forecasts, visual presentation of flooding, ring dikes, floodpads, the Floodway, emergency planning, etc.). The second respondent succinctly encapsulated this need for such a risk strategy.

Agree. But with the caveat that it has to be in balance with the threat. Again this must be part of a provincial integrated all-risk strategy. What needs to be in place is an integrated real time risk assessment program, which provides on going timely information as to potential risk with timely information, education and response preparedness information. This needs to be done on a tiered basis with all levels in synchronization as to content and direction. [Institutional respondent #05]

4.3.5 – Effectiveness of Information Communication

A common issue among hazard and disaster literature is that often times, information regarding risk is too technical and complex for local citizens to understand. This issue has been a specific concern in the Red River Basin (see IJC, 2000b) and was mentioned by some Institutional Representatives and a number of Flood Area Residents during the Phase One interviews. As such, a statement addressing this issue was posed on the Phase Two survey in order to examine Institutional Representatives' perceptions on the issue and to investigate possible solutions that may aid the communication of risk.

During an event, local communities receive information that is too technical and complex in nature. This requires attention so that local communities receive relevant and useable information regarding all hazards and emergencies.

The positions that were selected in response to the above statement are noted in Table 32.

Table 32: Delphi Phase Two – Effectiveness of Information Communication

Institutional Representatives' Responses to Question #17								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	0	0	**0**	**0%**			
A	4	1	1	**6**	**60%**		6	60%
D	1	2	1	**4**	**40%**		4	40%
SD	0	0	0	**0**	**0%**			
NC	0	0	0	**0**	**0%**		0	0%
DQ	0	0	0	**0**	**0%**		0	0%
Total	**5**	**3**	**2**	**10**	**100%**		**10**	**100%**

Analogous to the results from the previous section, a small majority of respondents indicated agreement with this issue statement (i.e. 6 out of 10). Senior government respondents generally agreed with the statement (i.e. 4 agree and 1 disagree), local government respondents were more in disagreement (i.e. 1 agree and 2 disagree), and non-government respondents were divided (i.e. 1 agree and 1 disagree).

Often, the value of a message can be lost in the transmission, so the key remains to effectively communicate the message without compromising the intended meaning. To achieve such a goal, experts must work with locals to develop a communications strategy that meets the needs of all parties. Reasoning provided by some respondents reflected this notion. The respondents noted that the issue has been recognized and attempts are being made to address shortcomings, but more needs to be done to solve the communication problems that arise from the complex nature of technical concepts.

> *Emergency responses and exercises have shown the improvements [that] have been made but that more can be done to improve communication. Emergency management agencies must find ways to communicate in plain language while maintaining content. At the same time local resource users must improve their knowledge of technical issues if they are in a position of responsibility ("meet in the middle").* [Institutional respondent #04]

This is an important issue, since good information may be ignored if not properly understood. It is necessary for the agencies to provide information clearly and in simple terms. Explanatory information should be sent to locals during the off-season to educate them on the meaning of terms and concepts. [Institutional respondent #03]

Agencies need to work closely with local emergency response officials to facilitate understanding and communication. [Institutional respondent #02]

The principle [is] that the more complicated the text [is] the less likely it will be understood. The thicker the brochure the less likely it will be read. On one occasion in the 1997 flood, a resident was given some 27 pamphlets to correspond with her situation. What she needed was someone to just tell her what she needed to do. [Institutional respondent #05]

The above comments indicate that the participating institutional organizations believe that more could be done to achieve solutions to communication problems. The key remains whether the political will exists to commit the resources required to carry out an effective risk communication strategy. Resources are necessary to implement the ideas suggested above and political commitment is needed to provide these resources and to support plans that would aid the communication process.

Institutional Representatives who disagreed with the statement expressed the sentiment that efforts are already being made to address this issue.

All forms of information are disseminated to all communities. [Institutional respondent #01]

That hasn't been my experience! If local community leaders don't understand water levels and land elevations then they should hire someone during an event that does. [Institutional respondent #07]

I feel that recently the Province and City have been more sensitive to the type of information given. [Institutional respondent #11]

The above comments suggest that for some organizations communication problems are not an issue. The first comment states that information is already being disseminated to communities; a follow-up question that arises is whether the organization

is reciprocating and speaking with communities regarding the effectiveness of these communications. Considerations such as: 'is the information useful, understandable, or relevant to the local region,' need to be addressed in order to ensure the information is beneficial for the community. One of the best ways to effectively communicate with the information users is to generate a two-way dialogue that facilitates the needs of all parties involved. If changes are needed to make the information more effective, the distributing organization must receive feedback from the users and receivers of the information.

Based on the relative divergence in terms of positional preferences, the variation among reasoning, and relevance to the scope of the study, this statement was examined further on the Phase Three survey. Results from Phase Three are noted in Table 33.

Table 33: Delphi Phase Three – Effectiveness of Information Communication

Institutional Representatives' Responses to Question #9								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	0	0	**0**	**0%**			
A	2	1	1	**4**	**50%**		4	50%
D	2	1	1	**4**	**50%**		4	50%
SD	0	0	0	**0**	**0%**			
NC	0	0	0	**0**	**0%**		0	0%
DQ	0	0	0	**0**	**0%**		0	0%
Total	**4**	**2**	**2**	**8**	**100%**		**8**	**100%**

Phase Three results differed slightly from Phase Two results as respondents moved from a majority in agreement to an even split (i.e. 4 agree and 4 disagree). Senior government respondents shifted from a majority in agreement to an even split (i.e. from 4 agree and 1 disagree to 2 agree and 2 disagree), local government respondents shifted to an even split (i.e. 1 agree and 1 disagree), and non-government respondents remained stable (i.e. 1 agree and 1 disagree). Once again the shift may be due to a reduced sample size from participant dropout. Table 34 provides a comparison of Phases Two and Three.

Table 34: Phase Two and Three Comparison – Effectiveness of Information Communication

Institutional Representatives' Responses Phase Two Question #17 & Phase Three Question #9								
	Total P2	Total P3	Percent P2	Percent P3	Total A/D P2	Total A/D P3	Total Percent P2	Total Percent P3
SA	0	0	0%	0%				
A	6	4	60%	50%	6	4	60%	50%
D	4	4	40%	50%	4	4	40%	50%
SD	0	0	0%	0%				
NC	0	0	0%	0%	0	1	0%	0%
DQ	0	0	0%	0%	0	0	0%	0%
Total	10	8	100%	100%	10	8	100%	100%

The comments provided by Institutional Representatives on the Phase Three survey verified prior reasoning contributed in Phase Two. While there was a change in the overall distribution of responses, the comments provided did not offer any explanations for these changes in position. The comments of one respondent introduced a new point for discussion that supported a supposition from Phase Two.

> *Some specialists are better at communicating technical information than the media types, who often get things twisted around. But, we need to know what it is that people don't understand.* [Institutional respondent #03]

Often the media can distort or misinterpret scientific facts that can mislead public perceptions of technical data. This relates to the theory of the social amplification of risk, as a message can be altered depending how many transmitters it passes through. If at all possible, direct communication from the source to the receiver with clear and simple information is the best means for communication as it reduces message distortion.

The latter part of the comment indicates that the concept of two-way information exchange discussed earlier is not currently occurring and may or may not be a goal of some institutional organizations. This respondent noted that from their institutional perspective they need to know what it is about objective risk and technical information

that is too complex for laypeople to understand. Again, this knowledge could be achieved through a two-way dialogue between the pertinent organizations and the local residents receiving the information. Decision makers cannot intuitively know what local residents require and what they do or do not understand without speaking to them.

4.3.6 – Evacuation Procedure and Management

A key issue raised by a number of Flood Area Residents during the Phase One interview process was mandatory evacuation orders. Specifically, a number of South respondents mentioned that based on their experiences during the 1997 flood, in the event of another major flood they would likely defy a mandatory evacuation order. Due to the potential implications of such behaviour for those organizations involved in managing flood response, it was decided to include the following statement concerning this issue on the Institutional Representatives' Phase Two survey.

> *Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages while some of those who defied the evacuation order were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.*

A breakdown of the responses to the above statement can be noted in Table 35. Of particular note with this statement is that only half of the sample chose to select a position (i.e. 5 out of 10). The majority of respondents who chose a position noted agreement (i.e. 4 out of 10) and were aware that in the next flood some residents are likely to defy an evacuation order. Interestingly, the other half of the sample (i.e. 5 out of 10) chose to have 'no comment' with respect to the Likert scale response (some of these respondents provided reasoning that will be discussed later). Senior government respondents were in agreement or had no comment (i.e. 2 agree and 3 no comment), local

government respondents were divided (i.e. 1 agree, 1 disagree, and 1 no comment), and non-government respondents agreed or had no comment (i.e. 1 agree and 1 no comment).

Table 35: Delphi Phase Two – Evacuation Procedure and Management

Institutional Representatives' Responses to Question #21								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	0	1	0	**1**	**10%**			
A	2	0	1	**3**	**30%**		4	40%
D	0	1	0	**1**	**10%**		1	10%
SD	0	0	0	**0**	**0%**			
NC	3	1	1	**5**	**50%**		5	50%
DQ	0	0	0	**0**	**0%**		0	0%
Total	**5**	**3**	**2**	**10**	**100%**		**10**	**100%**

Those respondents that agreed with the statement appear to have had previous experience with residents regarding this issue. The reasoning provided expressed much of the sentiment observed during the Phase One interviews with Flood Area Residents.

> *Residents were frustrated that they couldn't stay and protect [their properties].* [Institutional respondent #10]

> *Local decisions are necessary – not those made behind the gates and the dike in a dry city.* [Institutional respondent #08]

> *It will be defied, but some will suffer harm as a result.* [Institutional respondent #02]

> *But [it] is not just for this reason. The instinct, especially in the rural areas is to be independent and to look after yourself, never mind the government.* [Institutional respondent #05]

The last comment points out one of the key contributing elements to the South respondents' views on evacuation. Many of the South respondents are independent landowners and business people living on rural homesteads. These people tend to lead independent lives (i.e. less reliance on community and essential services) and as such, cannot be dealt with in the same manner as urban residents. Emergency managers must recognize these differences and act accordingly when dealing with rural residents. Most

of the South respondents are not as dependent upon government or local councils as urban citizens and are more willing and able to act on their own; thus the strong desire to remain behind and protect their property. Consequently, a great deal of contention is created when a non-local bureaucrat, albeit with good intentions, tries to tell these independent rural landowners how they should manage a flood situation.

As mentioned previously, some of the respondents whose chose to have 'no comment' on the Likert scale response did provide reasoning for their indecision.

> *It is government policy to protect individuals before property.* [Institutional respondent #01]

> *Evacuation decisions should be made by knowledgeable people in each municipality, based on information as to the flood risk, the risk to inhabitants and the odds of reducing damages without significant risk of life.* [Institutional respondent #03]

The first comment restates the common government policy of protecting lives before property. While few respondents disputed the importance of protecting lives, they noted that evacuation policy should be based more upon risk factors than upon an all encompassing, mandatory course of action aimed solely at preventing the loss of life. The second comment provides a different thought process and is more reflective of what some Flood Area Residents supported and termed an area-by-area evacuation process. Not only does the latter comment include local input, it accounts for risk factors, the loss of life, and the protection of property. Based on the responses from some South respondents, this latter option seems more feasible and is one that independent rural residents may be more willing to accept rather than a widespread mandatory evacuation.

The ancillary comments provided by another respondent, who agreed with the original statement, builds on this last concept. The respondent clarified that from an institutional perspective, changes have been made to evacuation policy since 1997.

According to the respondent, the *Manitoba Emergency Plan* has been modified since 1997 to address the blanket mandatory evacuation policy that was utilized in 1997.

> *The Manitoba Emergency Response plan now contains a policy on flood fighting and evacuation, with progressive levels of evacuation against levels of water. This was developed and inserted post 1997. See Guideline for Safe Habitation and Emergency Management in the Designated Flood Zone not including Valley Town Dikes. The new policy ... permits for the fighting for homes under rational conditions. The one key informal directive one must adopted is to try and not have to stand by a grave after the flood. There will always be those who will take life risks in spite of advice. That does not mean we should condone it. We need to put rational policies in place [that] will protect the irrational. Bottom line is there will not be a need for blanket directive given the new policy. Remember too that in spite of all we say, the practicality of enforcement is almost impossible. We do not have enough people to sandbag let alone arrest every person who wishes to sneak into harms way.* [Institutional respondent #05]

The problem herein is that it does not appear the policy change has been communicated to the local residents. While participants of this study were not directly asked about the amended evacuation policy, none of them discussed it or indicated an awareness of it; most respondents expressed the presumption that the procedures used in 1997 would be applied in future floods. In order to prevent problems during the next flood (i.e. confrontational situations) clear communication to residents regarding this new policy must occur prior to the next flood. With residents being largely unaware of the policy there is a greater chance that discrepancies could arise during implementation in an emergency. Addressing this issue during non-emergency times would be beneficial for all parties and could potentially prevent or at least identify possible limitations.

4.3.7 – Effectiveness of Flood Frequency Information

Another issue identified during the Phase One interviews with Flood Area Residents that may have implications for Institutional Representatives relates to flood frequency. The notion that local residents do not easily comprehend the risk variables

surrounding flood recurrence is important for those institutions tasked with communicating flood risk. If residents do not understand magnitude and probability, then efforts at communicating the level of objective risk and flood return periods are likely to be ineffective. Based on the Phase One findings, the following statement was posed to Institutional Representatives on the Phase Two survey in order to examine their awareness of the issue and potential solutions they felt might aid the process.

> ***Flood frequency*** *(i.e. magnitude, probability) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

Institutional Representatives' responses to the above statement are noted in Table 36.

Table 36: Delphi Phase Two – Effectiveness of Flood Frequency Information

Institutional Representatives' Responses to Question #24								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	1	1	0	2	20%			
A	4	0	2	6	60%		8	80%
D	0	2	0	2	20%		2	20%
SD	0	0	0	0	0%			
NC	0	0	0	0	0%		0	0%
DQ	0	0	0	0	0%		0	0%
Total	**5**	**3**	**2**	**10**	**100%**		**10**	**100%**

The majority of respondents agreed with the statement (i.e. 8 out of 10) and expressed the perception that some local residents do not easily understand the concept of flood frequency. All of the senior government respondents agreed with the statement (i.e. 5 out of 5 agree), local government respondents generally disagreed (i.e. 1 agree and 2 disagree), and non-government respondents agreed (i.e. 2 agree).

The reasoning provided by those in agreement reflected the same general opinion; some residents do not understand flood frequency and it requires further explanation.

Other respondents indicated that while some explaining might be required for those residents who do not understand, the majority of residents understand the concept of flood frequency or should understand it. The issue statement also asked the respondents to put forward potential solutions that could address this communication problem.

> *Talk in reality and simplicity. Worst case is that we could have this [particular] situation. Percentages are always confusing, [e.g.] to include the current weather forecast of 10% chance of rain. Does this mean that 10% of the area will get rain or there is 1 day in 10 with these conditions will get rain? It could also mean both. Speak real. The water levels this year will be that of 1997 or a bit more. For most people, you need valid threat information. Has anyone ever faced down the valley with a real map of what 1854 (not sure on real date) would look like in Emerson and asked the Mayor what he is doing should it happen in the next 1-2 years. The erratic weather pattern of "global warming" enhances the potential that we will get another big one.* [Institutional respondent #05]

> *Educational material [should be] sent out to all flood survivors on the meaning of: 1 in 100 year flood and what does 2" above 1997 mean.* [Institutional respondent #10]

> *The remedies to the communication problem (i.e., interpretation of what a 1:100 flood means) is a brochure which should be prepared and sent out to all municipalities.* [Institutional respondent #03]

Interestingly, of all the suggestions put forth are 'information out' methods aimed at enhancing residents' perceptions of risk. While 'information out' is certainly a key action, 'information in' would also be beneficial in such instances. For brochures and other educational materials to be successful communication tools, the organization producing them should discuss content with the local communities and then take draft versions to them for comments. If local community members are able to meaningfully contribute to the material, then perhaps they will be more likely to endorse and utilize it.

Based on the pertinence of the issue to the scope of the study and the reasoning provided, it was decided to carry this statement forward onto the Phase Three survey. The results from the Phase Three survey are noted in Table 37.

Table 37: Delphi Phase Three – Effectiveness of Flood Frequency Information

Institutional Representatives' Responses to Question #12								
	SG	LG	NG	Total	Percentage		Total A / D	Total Percent
SA	1	0	0	1	12%			
A	3	0	2	5	63%		6	75%
D	0	2	0	2	25%		2	25%
SD	0	0	0	0	0%			
NC	0	0	0	0	0%		0	0%
DQ	0	0	0	0	0%		0	0%
Total	4	2	2	8	100%		8	100%

Once again the group trend reflected the results from Phase Two and the majority of respondents agreed with the statement (i.e. 6 out of 8). Trends among the separate categories of Institutional Representatives also remained the same and the senior and local governments each lost one respondent to dropout. Table 38 provides a comparison of the summarized group responses from Phase Two and Phase Three.

Table 38: Phase Two and Three Comparison – Effectiveness of Flood Frequency Information

Institutional Representatives' Responses Phase Two Question #24 & Phase Three Question #12								
	Total P2	Total P3	Percent P2	Percent P3	Total	Total	Total	Total
SA	2	1	20%	12%	A/D P2	A/D P3	Percent P2	Percent P3
A	6	5	60%	63%	8	6	80%	75%
D	2	2	20%	25%	2	2	20%	25%
SD	0	0	0%	0%				
NC	0	0	0%	0%	0	0	0%	0%
DQ	0	0	0%	0%	0	0	0%	0%
Total	10	8	100%	100%	10	8	100%	100%

Most of the comments provided on the Phase Three survey did not add any new information to the study. The respondents who provided comments reiterated reasoning that had been noted on the Phase Two survey. One comment provided by an Institutional Representative suggested that local residents should take some responsibility with respect to understanding risk-related information so as to facilitate the communication process.

People need to have a basic knowledge of statistics, or else communication is too difficult. Not everyone will understand. I believe the younger generation will have a much better understanding. People should make it a point to understand the very basic things like return period. [Institutional respondent #03]

On a similar note, another respondent expressed a related comment in the additional space provided that also suggested local residents should take more responsibility with respect to hazard and disaster management.

Many of the questions in this survey focus on what government should or could do differently. What about the things that individuals can do:
1) Get involved.
2) Get knowledge.
3) Be prepared.
4) Take care of your own needs.
If the average individual could do the basics, emergency resources (limited as they are) could be directed to where they are most needed. [Institutional respondent #04]

Clearly, the psychosocial barrier that emerged during the 1997 flood still remains to some degree. Some Institutional Representatives felt that residents could do more to support the managing authorities and many Flood Area Residents felt that institutional experts could do more to aid the local residents. The only way a solution can be arrived at is for both sides to work together collaboratively and to bridge the gaps that do exist.

CHAPTER 5

GAPS IN RISK PERCEPTION AND FACTORS INFLUENCING PERCEPTIONS

5.1 – Introduction

The results of this research have clearly shown that perceptions of risk play a pivotal role in local residents' response to flood events in the Red River Basin and consequently, hold many implications for decision makers. Diverse issues were generated from Flood Area Residents and Institutional Representatives, of which some were more notable and emerged as common patterns among the data. One pattern that emerged was the existence of a gap between the views of Flood Area Residents and Institutional Representatives. In addition, other trends and patterns became apparent through the Delphi Process and were identified as factors that influence risk perception and may play a significant role in preparedness and response to future flood events. Building on the results discussed throughout Chapter 4, the goal of this chapter is to: 1) analyze the existence of a gap between perceptions of Flood Area Residents and Institutional Representatives, and 2) distinguish factors that influence risk perception and provide a discussion of their pertinence to hazard and disaster management in the basin.

5.2 – The Gap Between Institutional Experts and Flood Area Residents

As noted in the literature (Slovic et al., 1974; Burton and Pushchak, 1984; Cutter, 1993), there are marked differences between the perceptions of laypeople and experts. It has been asserted that experts' perceptions of risk are based on rational objectively calculated measures of probability, whereas lay perceptions are based on more subjective estimates of risk that are not probabilistic and involve cognitive limitations. Consequently, one of the primary objectives of this study was to determine if any

variation existed between the subjective perceptions of local residents and the perceptions of institutional experts in the basin. The findings from the Delphi Process supported postulations put forward in the existing literature in some cases, as there was noticeable variance between the views of Flood Area Residents and Institutional Representatives. In other instances the findings digressed, as some Flood Area Residents exhibited perceptions that indicated a general understanding of objective risk. The goal of the first major section in this chapter is to discuss these results and examine the study findings.

5.2.1 – Flood Area Residents' Perceptions of Flood Risk

Two issue statements from the Delphi Process that dealt with Flood Area Residents' perceptions regarding flood recurrence produced findings that deviated from notation in the literature (see sections 4.2.3 and 4.2.4). Researchers (e.g. Kates, 1962) have observed that laypeople tend to misperceive or misunderstand flood return periods. A common misperception is that after a low probability, high magnitude event has occurred many laypeople believe that they will not experience another equivalent event in their lifetime and do not need to worry about risk. Slovic (1986) reasoned that in an attempt to reduce the anxiety caused by the uncertainty associated with risk, individuals deny the uncertainty in order to make the level of risk seem so insignificant that it can be ignored. The errors that cloud subjective perceptions often arise from the use of heuristics, which can be fallible and can lead the individual away from a true understanding of the objective or real risk (Slovic, 1987).

Based on these notions from the literature, it was hypothesized prior to the Delphi Process that many Flood Area Residents would exhibit misperceptions similar to those noted above. However, the results of the Delphi Process exemplified that the subjective

perceptions of flood risk exhibited by many Flood Area Residents' did not differ significantly from the perceptions exhibited by experts. Most Flood Area Residents did not display the errors in judgment that were expected based on the literature. In fact, most respondents expressed the perception that they expected floods equal to or larger than 1997 to recur at some point during their lifetime. This finding suggests that due in part to the experience of the 1997 flood, many Flood Area Residents have a heightened awareness of flood risk (i.e. they perceive the probability that a 1997 level flood could occur in any year). These perceptions relate to the objective risk calculated by experts and indicate that the perceptual gap between Flood Area Residents and Institutional Representatives is not as wide as expected. Other issue statements used in the Delphi Process also generated perceptual responses that exemplified a general understanding of objectivity by Flood Area Residents (see sections 4.2.5, 4.2.6, 4.2.7, and 4.2.9).

A factor contributing to this heightened awareness of flood risk may be the temporal proximity of the study to the 1997 experience. Prior to the 1997 flood event, Flood Area Residents' awareness of risk would likely have been much lower than it is currently. As noted previously, when disasters do not occur for long periods of time a great deal of complacency sets in and perceptions of risk tend to diminish; as perceptions fade the gap in understanding between perceived risk and objective risk increases.

Another factor influencing this gap is the age of the respondents. Most of the respondents in this study who did not express a heightened awareness of risk noted that age was the key factor influencing their perceptions. These respondents have chosen to ignore flood risk by denying the associated uncertainty based on their older age. While these respondents did not explicitly state that a 1997 level flood will not occur for another

100 years, some perceive floods to be cyclical phenomena (i.e. major floods occurred in 1950, 1979, and 1997) and are confident that a major flood will not occur for another 20 to 30 years. Based on this cycle and their ages, they do not expect to be around for the next flood and as such, perceive that they do not need to worry about flood risk.

5.2.2 – Institutional Representatives' Perceptions of Flood Risk

Another notable finding from the Delphi Process, related to the variations between residents and experts, is that experts' perceptions do not appear to be entirely objective and often involve an element of subjectivity. Based on job-related training and knowledge, experts have a good degree of understanding of real risk and are expected to act objectively when making decisions. Even so, " experts' judgments appear to be prone to many of the same biases as those of laypersons, particularly when experts are forced to go beyond the limits of available data and rely on intuitions" (Slovic et al., 1982b, p.85). The 1997 flood response exhibited such a situation, where many experts were forced to go beyond written plans and policies and manage the situation in an ad hoc manner.

Since a 1997 level flood had not been experienced in more than 100 years, "the eventual magnitude of the response ... was not anticipated and many plans had to be adjusted throughout their implementation" (McNeil, 2000, p.59). Some Institutional Representatives noted that in 1997 many of the decisions made during the response phase did not follow written plans and procedures for various reasons (e.g. not enough time to consult them, they were outdated or no longer applicable, and in some cases required plans did not exist). This finding supports the notion that an element of subjectivity was involved with institutional decision-making processes during the 1997 flood response. Based on the supposition noted by Slovic et al. (1982b), the same biases that influence

laypersons' perceptions of risk would have influenced the subjective judgments made by experts managing the 1997 flood. The prior assumption was that since expert decisions were based on objective risk factors, they would be noticeably different from lay perceptions that were based on more subjective factors. Clearly though, both experts and residents utilize subjective factors in their perceptual and decision-making processes.

Another notable point to consider is that institutional representatives will likely have their own personal values and beliefs that may not necessarily coincide with those of the organization they represent. As such, when making decisions institutional representatives may try to remain objective, but some of their personal values may in fact influence the decisions they make (e.g. when they are forced to go beyond written plans and make decisions based on intuition). In some instances if the particular expert happens to be the director or lead decision maker for the organization, the policies and direction of the organization may reflect the personal values of the leader. As such, the potential exists that an expert's personal perceptions of risk, which may be somewhat subjective, could influence decisions made at an institutional level. Once again, this suggests that the gap between laypersons' and experts' perceptions of risk may not be overly substantial, as institutional decision-making may involve a degree of subjectivity.

The objectiveness of decision makers is an important consideration for hazard and disaster management. Risk management involves the integration of "an 'objective' process of determining what is known about the risks and a judgmental or 'subjective' process of deciding what can be done about the risks" (Gough, 1998, p.114). While the technical determination and assessment of flood risk is objective, the management of that risk is guided by subjective judgments. Since many of the decision makers in the basin

are not trained as risk assessors, one would expect that as risk managers their perceptions are more subjective and reflective of personal values. This suggests that the gap between the perceptions of Institutional Representatives and Flood Area Residents in the Red River Basin of Manitoba is not as significant as expected based on the literature.

5.2.3 – Institutional Representatives' Perceptions of Local Residents

A common trend among Institutional Representatives' responses throughout the Delphi Process was the lack of a clear understanding regarding local resident's issues and concerns. Based on the responses provided, it appears that this lack of understanding may be a contributing factor to the gap that does exist between experts and residents. For instance, responses to the issue statement that dealt with the effectiveness of information communication (see section 4.3.5) demonstrated the need for a two-way exchange of information to aid the communication process. One Institutional Representative expressed that institutions need to know what it is that local residents find too complex about risk communication and others noted that increased education and communication in plain language would aid the process. Another notable comment indicated the need for an improvement in understanding at the local level as well.

While the respondents recognized that a gap does exist due to the problems with respect to communication, unfortunately none of them identified cogent solutions (e.g. a two-way learning process and communications system). In order for education to be effective and for local level representatives to take more responsibility, they need to learn with and from those who have the knowledge – the institutional experts. In addition, in order to learn about residents' concerns, institutional experts need to meet with residents and incorporate their local knowledge into the decision-making process.

Other examples that illustrated the existence of a gap between Institutional Representatives and Flood Area Residents were apparent in the responses to the issue statements throughout the Delphi Process (see sections 4.3.1, 4.3.2, 4.3.3, 4.3.4, and 4.3.7). In some cases Institutional Representatives provided responses that expressed how they personally feel that Flood Area Residents perceive flood risk (no comments were provided by Institutional Representatives that indicated the assumptions were derived from direct contact with residents). Based on their assumptions, these Institutional Representatives indicated that local residents do not accurately perceive flood risk and as a result, are not properly aware of the objective risk. In discussing the priority of disaster issues, one Institutional Representative expressed the belief that the success of mitigating the 1997 flood may have caused attenuations in perceptions flood risk among local municipal officials and local residents. Based on the findings from the Delphi Process regarding Flood Area Residents' perceptions of risk, this does not appear to be the case for the most part (see section 5.2.1).

Similarly, in discussing the role of structural mitigation measures an Institutional Representative expressed that many local residents believe that since the worst threat has been managed (i.e. 1997) flood protection up to 1997+2 feet has circumvented future danger. Another respondent felt that residents in southern Manitoba have a false sense of security from flood protection at 1997+2 feet and perceive that they are floodproofed. As noted earlier, throughout the Delphi Process many South respondents stated that they do not perceive flood protection at 1997+2 feet to be sufficient (see section 4.2.6). Due in part to a general understanding of the objective risk, many South respondents expressed a heightened perception of risk and a desire for enhanced flood protection above 1997+2

feet. These examples exemplify that the psychosocial barrier that developed in 1997 has persisted to this day as some Institutional Representatives are of the opinion that local residents do not properly perceive flood risk. This has resulted partly from a lack of understanding due in part to a deficient communication process – if the two sides were conversing with each other then they would likely have a better understanding of each other's positions, which do not seem to be too far apart with respect to their perceptions.

5.2.4 – Deficiencies in Communication

One of the findings from the research that supported the existence of a gap between experts and residents emerged regarding perceptions of evacuation procedure and management. An issue statement that addressed emergency evacuation was posed to both Flood Area Residents and Institutional Representatives (see sections 4.2.8 and 4.3.6). Many Flood Area Residents perceive that since losses were incurred during the 1997 flood because of mandatory evacuation, in future floods similar evacuation orders will likely be defied. Besides ensuring that their immediate family is safe, the foremost priority for Flood Area Residents is protection of personal belongings and their homes. Some Institutional Representatives expressed awareness of these views held by the respondents (i.e. that many residents intend to defy future evacuation orders), but noted that the accepted government policy is to first protect lives and then to protect property.

At first glance this issue appears to clearly exemplify a gap between the perceptions of potential victims and experts. The accepted policy noted by Institutional Representatives details that the threat to human life is of paramount importance; evacuation orders are carried out in instances when the flood threat reaches a certain level and poses a threat to human life that supercedes the protection of property. Nevertheless,

in the eyes of some residents the protection of property is perceived to be more important than evacuation. The issue comes down to a trade-off on the part of some residents who perceive that the risk to property is greater than anything else under consideration.

Based on the responses from Flood Area Residents, it does not seem that this trade-off choice has resulted from misperceptions of objective risk. As noted earlier, most respondents have some level of understanding with respect the objective flood risk in the basin and are not unwittingly putting their lives in danger. For many of these respondents the rationale for choosing to remain behind to protect their property is a based on personal experience and knowledge from past flood events. Many residents who have experienced floods have an acute understanding of flood risk that is not a result of scientific training, but rather it is experientially derived – which often translates quite well in real situations. A number of Flood Area Residents noted that they should not have been evacuated in 1997 because the flood threat in their area was not significant (e.g. one respondent only had a few feet of water on his property). Even in places where the threat was greater respondents felt that if they were adequately prepared, had evacuated their families, and had the necessary safety equipment, they should have been allowed to remain behind and given every reasonable opportunity to save their homes.

Rather than the quandary being a significant gap between residents' and experts' perceptions of risk, it appears there was a gap in the communication process in 1997. Many respondents were in situations where they were generally aware of the objective risk and their experience may have enabled them to save their home and reduce disaster losses. These respondents noted that they had emergency equipment in place (e.g. boat, cell phone, clean water, supplies, etc.) that would have allowed them to safely monitor

their homes, pumps, and dikes and still escape if required. However, flood management authorities downplayed these adaptations and instead implemented a blanket evacuation that prevented the loss of life, but contributed to the loss of many unmonitored homes.

Many homeowners evacuated in 1997 under the assumption that someone would monitor their homes and were devastated when no one undertook such action. Had there been prior communication between residents and decision makers, as well as guidelines for evacuation procedures, then perhaps these situations could have been managed differently. The flood was managed in a top-down manner where residents' concerns and abilities were not necessarily considered in the improvised evacuation decisions. If there had been proper communication and planning prior to the flood event then perhaps all parties could have reached consensus or least been aware of each others viewpoints. Local citizens "understand some things quite well, although their path to knowledge may be quite different from that of the technical experts" (Slovic et al., 1982b, p.85).

Since 1997 institutional organizations have recognized that the evacuation procedures utilized in 1997, while successful in preventing the loss of life, were not as effective in preventing property losses. For instance, some residents were evacuated from low-risk situations and their homes later flooded due to their absence. As noted in Chapter 4, evacuation procedures have been amended since 1997 to account for such limitations. Policy modifications have addressed some of the resident's concerns as the *Manitoba Emergency Plan* now contains action guidelines and trigger points that apply to properties protected by private ring dikes and floodpads in the Red River Valley (see Appendix 16). The guidelines also provide minimum criteria that must be met to allow *essential personnel* to remain behind to protect property in high-risk flood areas.

The problem herein lies in the communication of the new policy. Flood Area Residents were not aware of the evacuation guidelines and continue to formulate their perceptions based on past flood experiences. Even though a probable solution was implemented post-1997, the communication gap that produced problems in 1997 has not been resolved. If the apposite organizations communicated the guidelines to residents, the existing gap may be narrowed. Overall, the gap in perceived risk between Flood Area Residents and Institutional Representatives does not appear to be significant, but the gap that does exist relates to understanding and results in part from a lack of communication.

5.2.5 – Flood Area Residents' Perceptions of Institutional Experts

There also appears to be a gap between experts' and residents' perceptions of flood risk that was prevalent from the perspective of Flood Area Residents in the Delphi Process (see section 4.2.1). A number of Flood Area Residents perceive that experts' perceptions and knowledge of floods are too narrow because the experts do not live in the rural communities that they make decisions about. While this issue may or may not have merit from an institutional standpoint, it does contribute to the existence of a gap between residents and experts. Many rural respondents expressed concern that decisions are continually made without considering or consulting local communities and questioned the effectiveness of decisions being made without local input. Respondents cited various examples from the 1997 flood where expert's and decision maker's lack of understanding regarding local issues created further uncertainty and hardship for the residents.

A number of South respondents indicated that a potential solution to the above problem might be the use of community contact persons. These rural residents noted that in the post-1997 flood period one of their more positive experiences was dealing with the

experts who were involved in the floodproofing program and went out to households and spoke with homeowners. The respondents were pleased with the program because an institutional representative physically came out to their home and provided a personal assessment to the homeowner after viewing their situation. The key to the process was the personal contact; the respondents appreciated the opportunity to learn firsthand by asking questions and receiving answers on the spot. This method of communication was effective in bridging the gap in understanding between residents and experts at that time.

Based on this experience, some respondents expressed the desire for a dedicated community contact person. A beneficial outcome of a community contact person would be the two-way communication links that could be established. From an institutional viewpoint there would be increased awareness of local issues and from a resident's viewpoint there would be less uncertainty and increased awareness of flood-related issues. Most importantly, an improved communication process may contribute to a mutual understanding that could reduce the gaps between experts and residents. In addition, reducing the uncertainty faced by local residents may benefit hazard and disaster management by: 1) allowing residents to become better prepared for future flood events and consequently, increasing their resiliency, and 2) reducing the stress created by uncertainty, which may appease local residents and make public opposition a less likely process outcome (this would also reduce stress for institutional representatives).

The key remains whether the political will exists to commit the required resources to carry out an effective risk communication strategy. For instance, resources are required to develop educational documents that explain flood-related issues in simple, easy to comprehend terms. There must be a two-way process during development to

ensure that the final product is useful for residents and will not be discarded with the junk mail. One possible solution may be to have a dedicated government communications branch that could act as a liaison between the different levels of government and the local citizens. Such a branch could have a government-funded, properly trained community liaison in each rural municipality who could fill such a role (i.e. to aid local municipal governments that may not have the resources to hire a full-time staff person).

A staff person in a community liaison position could serve as a go-between from local residents to both the local and senior levels of government. This dedicated communication link could aid all parties involved and potentially reduce the gaps that appear to exist between residents and experts. The difficulty lies in convincing those allocating the funds to commit to a project in which the benefits may not necessarily be recognized during a four-year political time frame. For hazard and disaster management practices to be successful there is a need to manage beyond four-year political terms and promote sustainable policies that will reduce the vulnerability of future generations.

5.3 – Factors that Influence Perceptions of Risk

Another of the primary objectives of this study was to identify various factors that influence perceptions of flood risk at the local level (i.e. Flood Area Residents). The goal of the second major section in this chapter is to discuss the results from the Delphi Process that exemplified influencing factors. In accordance with the analysis of responses from Flood Area Residents throughout the Delphi Process, a number of specific factors commonly emerged. Each of the following sub-sections presents a specific risk perception factor that was ascertained from the Delphi Process findings.

5.3.1 – The Role of Geographical Location

It was originally hypothesized that geographical location would be a factor that influenced risk perception and that such perceptual differences could have notable policy implications. For instance, divergent perceptions throughout the basin may produce differing responses from residents that could impact hazard and disaster management, as decisions applied in one area of the basin may not be suitable when applied in another area where different perceptions predominate. As such, an additional objective of this study was to examine variations in perceptions of risk and flood-related issues in terms of geographical location. In order to carry out the stated objective, the sample design was developed in a manner so that respondents were selected from a broad geographic area.

The goal was to analyze the responses from residents living in different areas of the basin to determine whether they held similar or dissimilar views on the issues being addressed. While not statistically significant due to the small sample size, the research findings do suggest that an element of variance exists within the sample; supporting the hypothesis that there are geographical variations in perceptions in the basin. This is a prevalent subject matter that warrants further examination, as the notion of a difference in perceptions between Winnipeg and South respondents was a trend that appeared throughout many of the issue statements addressed during the Delphi Process.

The first issue statement from the Delphi Process that generated responses which exemplified the existence of geographical variations in perception dealt with the role of expert knowledge (see section 4.2.1). In this instance, Winnipeg and South respondents were notably divergent in their perceptions with respect to the issue statement (see previous discussion in section 5.2.5). The majority of South respondents agreed with the statement and perceived that institutional experts have very narrow perspectives because

they do not live in the rural areas that flood. Whereas, Winnipeg respondents were more divided on the issue as some agreed and others disagreed.

Another issue statement that generated responses which exhibited variations in perception dealt with trust and credibility (see section 4.2.2). Akin to the findings noted above, Winnipeg and South respondents provided differing perceptions with respect to the statement. A strong majority of Winnipeg respondents disagreed and indicated that they had positive experiences with government organizations during and after the 1997 flood. South respondents had different opinions, as a small majority agreed and noted that their experiences with government organizations in 1997 were somewhat negative.

As noted at the end of section 4.2.1, one of the reasons for this divergence in perceptions may be the respondents experience with specific institutional representatives during the 1997 flood. For many South respondents their experiences with institutional representatives were negative due to confrontational situations that occurred during and after the flood (e.g. mandatory evacuation and post-flood compensation). During these situations negative perceptions may have developed because some of the institutional representatives dealing with the residents were unfamiliar with local situations (e.g. MEMO hired many temporary damage claim case workers that did not have experience in the rural regions). As such, some South respondents perceived that institutional experts from Winnipeg who were unaware about local conditions or needs were making the decisions that affected them. For many respondents the product of this experience has been increased uncertainty and stress, which has led to public opposition and feelings of resentment towards the City. This issue may also be a contributing factor to the existence of a gap between experts and local residents (see section 5.2).

On the other hand, the 1997 flood experience in the City of Winnipeg was markedly different than it was in the rural areas of Manitoba. For instance, fewer Winnipeg respondents expressed discontentment with the fact that expert knowledge originates in Winnipeg (not unexpected) and subsequently, a number of these respondents noted that their experience with government officials in 1997 was positive. This characteristic may be associated with another dynamic contributing to the perceptual differences with South respondents – an inequity in the allocation of resources.

Since Winnipeg is a single urban administrative unit and its population is larger, the resources available are correspondingly large in comparison to rural municipalities that have much smaller populations and fewer resources. In fact, during the 1997 flood, the City redeployed approximately 2,700 civic employees to work in other departments and to aid in the flood response and also spent nearly $30 million on flood fighting and clean-up (McNeil, 2000). These figures exceed those expended in rural municipalities and indicate that there was a significant difference in the level of response provided. While this point is not intended to slight rural municipalities and critique their response capabilities, it is merely to illustrate that without the resources their ability to provide a flood response that meets the needs of all residents is significantly compromised.

Much of the rural flood response was undertaken by the residents themselves and not managed by authorities to the same extent as the City's response. While many Winnipeg homeowners valiantly protected their homes in 1997, they did have the benefit of the City facilitating the response to protect roughly 800 homes that were the most at risk and located outside the major flood control works (McNeil, 2000). In the rural areas it was the individual homeowners who had to take the lead responsibility to protect their

homes and much less support was provided from local governments due to the scarcity of resources. This limitation also has an effect in non-disaster times, as fewer resources are available in rural regions for emergency management and preparedness planning.

Another finding from the Delphi Process was that noteworthy differences in perception also existed within the two geographic regions surveyed. For example, when queried on the adoption of additional flood protection measures, respondents from different areas of Winnipeg revealed differing perceptions. In one neighbourhood that nearly flooded in 1997, respondents noted that the safety of their homes depended upon all homeowners because they shared a community dike; if one homeowner compromised their portion of the dike all of the homes could be lost, as the neighbourhood was only as strong as the weakest link. In order to increase their level of safety, after 1997 residents in this area chose to adopt and pay for a portion of enhanced flood protection that would protect the entire neighbourhood. Alternatively, a different neighbourhood that did not come as close to flooding in 1997, but was still at significant risk, chose not to adopt and pay for further flood protection measures after 1997. Respondents in this neighbourhood noted that they felt safe based on the 1997 experience and did not want to trade-off values such as aesthetics and lifestyle convenience for an added level of protection and safety.

A significant feature that emerged among Winnipeg respondents' perceptions of flood risk is the level of danger they faced in 1997 (i.e. how close their home came to flooding). As noted above, in the neighbourhood where the flooding was serious, but did not reach a point at which homes were perilously threatened, the respondents expressed lower perceptions of risk. These lower perceptions of risk then translated into an apparent reluctance to adopt further flood protection options due to the inconveniences

that would be caused in the respondents day-to-day lives. In contrast, in the neighbourhood where the flood threat was more serious and many homes came much closer to being inundated, many respondents expressed a higher concern about flood risk. This heightened perception appears to have been a factor in the respondent's willingness to adopt and pay for further flood protection measures. This is an area in which further research could be conducted to investigate direct correlations of perceptions of risk and threat levels with the willingness to adopt and pay for further flood protection measures.

Differences in perception also existed throughout southern Manitoba. For example, in the South respondent group perceptual variations were exhibited between respondents living on farms or homesteads and those living in communities protected by ring dikes. Rural homestead respondents expressed greater personal responsibility and noted that they were liable for the protection of their homes; these respondents were concerned with their immediate situation and whether personal flood protection levels were sufficient. Respondents living in ring dike communities were also concerned with saving their homes, but indicated that they had less control because someone else was responsible for managing and maintaining the community dike. Some of these respondents were uneasy because the safety of their home and community depended upon the actions of others. One particular respondent expressed trepidation because she had heard that the community dike was too low and had weak spots. The main difference between the situations of the two respondents is the notion of facing risk independently (i.e. rural farm or homestead) or facing the risk collectively (i.e. rural town or village).

Another related factor that influenced respondents' perceptions of flood risk was their specific geographical location in the basin. For instance, there were noticeable

variations in perception between respondents living in areas immediately upstream of the Floodway Inlet and those living further south towards the International Border. Respondents living in the area immediately upstream of the Floodway Inlet expressed amplified perceptions of risk and concern for the safety of their homes due to the operation of the Floodway. Respondents living further south near the border expressed concern about drainage from the United States and the resultant potential for exacerbated flood conditions in Manitoba. While both groups of respondents expressed concern about safety and the flood threat, the determinants or causes were from different risk-related variables that depended upon the specific geographical location of the respondent.

5.3.2 – The Role of Past Flood Experience

Kates (1962) and Haque (2000) noted the importance of past experience as an influencing variable in the perception of flood risk. Based on the nature of responses provided throughout the Delphi Process, it became apparent that past flood experience is a significant influencing factor for Flood Area Residents' perceptions of risk in the Red River Basin. Findings from the Delphi Process supported the literature as respondents' experiences with the 1997 flood event, and in some cases experiences with additional flood events including 1979 and 1950, have contributed to an increase in their awareness of flood risk. Due in part to the temporal proximity and enormity of the 1997 flood, it has remained the primary reference point for the majority of the respondents.

Since a high number of respondents disagreed with the statement that a 1997 level flood or larger will not recur in one's lifetime (see section 4.2.3), it appears that the experience of 1997 flood has significantly influenced perceptions of risk. It is likely that many of the respondents have a better understanding of probability and perceive that high

magnitude flooding will recur because of living through the 1997 flood (i.e. heightened awareness of flood risk). Some respondents noted that the 1997 flood was a learning experience and they have continued to learn about floods since then. This finding is supported by previously published research that found experience to be a significant factor in perceptions of risk. For example, Lopes (1992) found that "[m]ost people deny that a disaster could happen to them, or could happen where they are. Only those people who had actually experienced a flood, tornado, or earthquake where they lived were likely to admit that they thought a disaster could happen to them where they lived" (p.9).

If a similar statement regarding flood recurrence had been posed to Flood Area Residents prior to 1996 it is unlikely that a correspondingly high number would have indicated the same heightened awareness of flood risk. The last major flood prior to 1996 had occurred in 1979 and a great deal of complacency had developed in the basin at both the institutional and local levels when the 1997 flood occurred. Clearly, the 1997 flood experience was a learning event for all involved and due to its seriousness has persisted as a signal event for many who lived through it. The 1997 flood illustrated that based on the objective level of risk in the basin, many towns and homes remain at risk. As a result, flood-related issues have attained and maintained priority from both a management and public perspective since 1997. It appears that the level of complacency that developed in the post-1979 flood period has not yet returned to the basin in the post-1997 flood period.

Many Flood Area Residents noted that experiences from the 1997 flood event will never be forgotten and are permanent memories. During Phase One of the Delphi Process, each respondent made reference to the 1997 flood and clearly the event has significantly influenced current perceptions. As such, it is conceivable that the anchoring

and adjustment heuristic may be applied by some respondents. This heuristic involves individuals utilizing a natural starting point for their first estimation of a judgment (the anchor) and then making further judgments by adjusting this position based on additional information (Slovic et al., 1974). Subsequent perceptions tend to remain anchored to the original perception and it is unlikely that further information will significantly adjust perceptions (Burton and Pushchak, 1984). This concept suggests that the 1997 flood will influence perceptions of risk until a larger flood is experienced and supplants the anchor; just as the 1979 flood was the anchor prior to 1997 and the 1950 flood prior to 1979.

Based on conceptual underpinnings, the anchoring and adjustment heuristic may also influence some respondents' perceptions of flood risk during future events. As noted, perceptions may be tied to the 1997 event because it is the largest flood of recent experience. If these respondents do in fact affix future perceptions solely to the 1997 event and do not adjust their perceptions accordingly to new situations that arise, they may be more vulnerable by underestimating larger magnitude flood events. Based on the comments provided by a number of Flood Area Residents, it appears that many have a better understanding of flood risk than presumed in these concepts. Many respondents noted that flood events are unique and perceive that similar situations can be drastically altered by rapidly changing variables – significant rainstorms or windstorms in 1997 were examples cited. Respondents also noted that factors such as changing weather patterns and global climate change are creating unstable conditions that can alter flood recurrence.

The memorability of the 1997 flood event and the subsequent heightened awareness of flood risk displayed by some respondents support the existence of the availability heuristic. "The availability hypothesis implies that any factor that makes a

hazard highly memorable or imaginable – such as a recent disaster or film or lecture – could considerably increase the perceived risk of that hazard" (Slovic et al., 1974, p.195). From a risk management perspective the existence of this heuristic is not necessarily a negative incidence. It is anticipated that due to the memorability of the 1997 event and the heightened awareness that resulted, local residents are less likely to become as complacent as they did after the 1979 flood. An aware public that perceives flood risk is more likely to be prepared for and resilient in future flood events; a more sustainable alternative than an unaware and unperceptive population that is not prepared.

> *Extreme events also make one wiser, making preparations for high water easier. In 1997 we started preparing in January.* [South respondent #02]

The key lies in the ability of the residents to perceive that floods larger than 1997 can occur. As noted by Kates (1962), floodplain inhabitants generally perceive a risk from flooding only to the extent or magnitude that they have previously experienced, thus leaving themselves vulnerable in the event of larger floods. The memorability of past flood events plays an important role in the determination of how individuals will perceive and react to future events; "the biasing effects of memorability and imaginability may pose a barrier to open, objective discussions of risk" (Slovic et al., 1979, p.15). While some Flood Area Residents perceived that larger floods could occur, it remains to be seen whether the biasing effects of memorability will influence the perceptions of other residents. Based on the seriousness of the 1997 flood event, it is expected that in future floods residents will use these memories to aid comprehension of objective risk (e.g. using 1997 as a benchmark) rather than using them as barriers to comprehension.

Nevertheless, these biasing effects were apparent in 1997 as some respondents used the memorability of the 1979 flood event to establish their perceptions. These

respondents stated that they never expected the 1997 flood to reach such high levels; this illustrates that they significantly underestimated the risk due in part to the bias of past experience. Since many respondents had not experienced water levels of the magnitude that occurred in 1997, they expected levels to be similar to those from 1979.

> *Before in 1950 and 1979 the water went up and filled a low spot on the land, but in 1997 it kept rising and rising. We never believed the water could go that high. We never had to build a dike before.* [South respondent #04]

Based on past occurrences, it appears that the biasing effects of memorability may influence future perceptions of flood risk among some residents. The essential determining factor will be the magnitude of the flood – for floods equal to or less than 1997 the biasing effects may be small, but for floods larger than 1997 the biasing effects could potentially be significant and cause some residents to underestimate the real risk.

Other findings from the research provided further support for the notion that residents' perceptions of risk have been influenced by past experience with flood events. Some Flood Area Residents who had lived through floods prior to 1997 exhibited heightened awareness and adaptive behaviour based on their experiential knowledge. For instance, one respondent stated that as a result of the level of snow present during the winter of 1996/97 he realized that a significant spring flood would occur. Based on his personal risk assessment and past experience, he began preparing and moving livestock and grain in January and February of 1997 – well before public forecasts were predicting a record flood. Another respondent purchased land outside the flood zone prior to the springtime – one small parcel of land in the event that the flood was low in magnitude and he would only have to move part of his operation and a larger plot in case the flood was higher in magnitude and he would have to move his whole operation.

An additional instance where respondents illustrated the influence of experience on their perceptions of risk and subsequent behaviour was in reference to the post-flood government floodproofing program. Some respondents noted that enhanced flood protection up to 1997+2 of freeboard was not high enough for them to feel secure (see section 4.2.6). For example, one respondent cited prior experience and lessons learned.

> *After experiencing 1997 I realized that records will always be broken and earth settles – you can see how it has already settled in some places – so I built to 1997+4 with the hopes that with settling, when the smoke clears in 10 years I'm still at 1997+2.5 or 3 feet. Over time dikes settle and at 1997+2 I did not feel that decades from now my family would be safe. I would like to see a program to monitor and resurvey dikes in 10 years because a dike needs maintenance and may need to be fixed up in awhile. I try to watch for gopher holes. In 1979 a neighbour on the other side of the river had a dike that was built straight up and down and he felt quite proud and comfortable behind it. In 1997 the water came up and over it and when they surveyed it after, turns out it had settled 3 feet.* [South respondent #14]

The above respondent also noted that his dike had settled after the 1979 flood and during the 1997 flood he had to scramble to fix low spots and weak areas. Other South respondents expressed similar recollections regarding dikes built after the 1979 and 1950 floods. The above respondent has a heightened awareness of risk due to the experience of numerous past flood events as a rural homeowner. The key is that he perceives and is aware of future flood risk and is taking precautions to protect his family for the present as well as for the future. This respondent offers a progressive viewpoint; he has 'learned to live with the flood risk' and has also been adaptive based on past experience.

The above respondent also raises an interesting point with regard to the issue of dike settlement and decreased flood protection levels over time. While the Province is the authority that oversees the maintenance of community ring dikes and flood control works, there are no monitoring and evaluation programs in place for individual homeowners. The maintenance of personal flood protection is up to the discretion of the

homeowner. Perhaps a government funded evaluation by certified engineers and surveyors every ten years could assess the levels of home ring dikes and floodpads. Homeowners do not possess the technical expertise or expensive diagnostic equipment required to properly survey property and need support in this regard from government.

A significant number of homes and residents could potentially be at risk in future flood events if these flood protection levels are not monitored and maintained. Evacuation guidelines are now based on threshold water levels being reached; if floodpads or dikes have unknowingly settled below these threshold levels prior to an event, residents could conceivably be at greater risk before they would expect to be. The potential exists that significant damages could be incurred and residents put in danger during the next flood if response actions are carried out under the assumption that a home is floodproofed to 1997+2 feet, when in fact it has settled to 1997+0 feet or less. It may be prudent to address this problem prior to an event in non-emergency times, than to wait until an event occurs and residents are left more vulnerable. In 1997 many dike elevation surveys were not conducted until the flood crest was approaching and residents were left scrambling to raise dikes that had settled below the standard flood protection levels.

5.3.3 – The Effect of Uncertainty

Based on the results of the Delphi Process another key factor influencing residents' perceptions of flood risk is the concept of uncertainty. A number of South respondents expressed that the proposed Floodway Expansion project has created a great deal of uncertainty in their lives. The primary concern is that the potential impacts of such a project have not been clearly communicated to the rural residents living outside Winnipeg that may be affected. Many South respondents were unsure about what major

changes to flood control works will be implemented with the Floodway expansion and what the subsequent effects might be. "A major problem can occur when different participants do not have access to information" (Mitchell, 2002, p.296). Associated with this uncertainty has been public opposition to the Floodway Expansion project in some of the areas where potential effects have not been clearly communicated.

At the time of the research, some South respondents expressed concern that the proposed expansion of the Floodway would exacerbate flood conditions in certain areas; specifically in the regions immediately upstream of the Floodway Inlet and south of the West Dike. This finding relates to the notion of geographical variations in perceptions, as the concerns are specific to the respondent's physical location. Respondents living in these areas perceived that Floodway expansion will cause more water to back up onto their properties and render flood protection levels of 1997+2 feet as inadequate. Based on experiences from 1997, respondents expressed concern that since these structures (i.e. Floodway Inlet and West Dike) backed up water onto their properties in 1997, any increase in their height or mechanical changes will enhance the back-up of floodwaters and worsen their personal situation. For example, by increasing the West Dike by two feet, some respondents perceive that they will receive an extra two feet of water on their property during a flood and this will overtop their flood protection and flood their homes.

> *We felt secure at 1997+2, but now with the West Dike raised we feel less secure. Will we get compensated if we are flooded out next time? We protected to the levels that we were told, but now that might not be enough. They are going to have to consider extra protection out here if they raise the West Dike for Floodway Expansion. What are the government's plans for this?* [South respondent #15]

Related to this uncertainty has been amplification of the respondents' perceptions of flood risk. Since the respondents perceive that an increase in the height of the West

Dike will make flooding worse in their community, their perception of personal safety has been altered. These respondents no longer feel safe living in homes floodproofed to the 1997+2 feet flood protection level due to the uncertainty associated with Floodway expansion. Another potential outcome associated with uncertainty may be an increase in stress for the affected homeowners during disaster times. While the uncertainty amplifies perceptions during non-disaster times, it may increase stress during a disaster because the respondents will be unsure of the effects of the higher West Dike. No communication had been provided to the respondents at the time of the research to explain or detail potential adverse effects. As such, they are left to formulate judgments based on personal experiences from 1997 and from word of mouth in the community.

An observation by Williams et al. (1999) is analogous to the outcome of the situation that has developed in the Red River Basin. "This lack of knowledge could slowly fester and result in greatly amplified risk perception and public opposition in the future" (Williams et al., 1999, p.1033). Such an outcome has transpired with respect to the lack of information and associated uncertainty that potential changes to flood control works have caused for some South respondents in the 1997 flood affected regions. Based on findings in this study, the lack of information on the potential effects of a higher West Dike has resulted in amplified perceptions of risk for respondents living in the region immediately south of the dike. Similarly, respondents living immediately upstream of the Floodway Inlet expressed amplified perceptions due to concern about the potential effects of Floodway expansion and subsequently noted opposition to the expansion project.

Another critical aspect is that the issue of uncertainty in relation to the Floodway has persisted since the structure was first put into operation 36 years ago. Some

respondents were long-time residents of the area and noted that there has been concern with the effects of the Floodway since it was completed in 1968. Many residents living upstream of the Floodway Inlet opposed the original project in the 1960s and their experiences during floods in 1974, 1979, 1996 and 1997 only intensified their concerns. The respondents noted that there has been inadequate provision of information all along and while their concerns have increased after each flood, no tangible answers have ever been provided to their questions. After the 1997 flood some of the residents in this region formed a citizens group – the North Ritchot Action Committee. This committee has attended many flood-related meetings in the basin and vehemently opposed operation of the Floodway and contended that their issues have not been adequately addressed.

Despite recent and more vigorous attempts by the Manitoba Floodway Expansion Authority to address the concerns of residents in this region and provide information on the Floodway Expansion project, at this point in time any attempts to move forward with the project have been met with the passionate opposition that has become characteristic from this citizen's group. Research findings from Slovic et al. (1982b) clearly conform to the outcome that is unfolding in the Floodway Inlet region.

> Research ... indicates that disagreements about risk should not be expected to evaporate in the presence of evidence. Strong initial views are resistant to change because they influence the way that subsequent information is interpreted. New evidence appears reliable and informative if it is consistent with one's initial beliefs; contrary evidence tends to be dismissed as unreliable, erroneous, or unrepresentative (Slovic et al., 1982b, p.85).

Notwithstanding new studies and a commitment that the expanded Floodway will benefit upstream residents, the longstanding discontent and opposition has remained. A small group of residents have developed strong views, based on more than 30 years of personal experience in some cases, and appear unwilling to accept new information being

provided to them. One respondent was skeptical that Floodway expansion will benefit their community because this was the same message government officials declared to them in 1968 when the original Floodway was built and their experiences have proven otherwise. It is likely they will only be convinced if and when the physical operation of the expanded Floodway actually affords them the benefits they are now being promised.

5.3.4 – The Effect of Disaster Images

One of the issue statements that generated a significant amount of reasoning and varied responses dealt with the visual presentation of the flood based on the disaster in Grand Forks, North Dakota in 1997 (see section 4.2.9). In accordance with the reasoning provided by respondents, it appears that in some cases the visual presentation of the flood had a prominent influence on perceptions of risk in the basin. Many Flood Area Residents noted that viewing the Grand Forks situation on television or in the newspaper in 1997 made them take notice and convinced them of the seriousness of the situation. Some respondents stated that as a result of a sudden awareness of danger (i.e. heightened perceptions of risk) they began to take preventive actions such as removing personal belongings from lower areas and preparing sandbag dikes to protect their property.

These preliminary findings suggest that in some cases the use of disaster images can aid preparedness and response activities by convincing the public of the seriousness of a flood threat and influencing perceptions of risk. Nonetheless, further research is required to directly correlate the role of disaster images with perceptions of risk and subsequent preventive actions and behaviour. One reason for the influence of these disaster images may be the characteristic northward flow of the Red River. If the disaster images had been from a different region it is unlikely that they would have had the same

influence on perceptions. The key is that the Grand Forks images were a precursor of what was coming down the river (since flooding in the basin is a slow onset event). Viewing the images allowed some residents to personalize the situation and realize that the vast quantity of water would reach their homes at some point in the weeks following. This provided them with time to get prepared and take preventive actions. "It is important for people to believe a disaster can happen to them, so they will personalize the risk and be motivated to take appropriate preparedness measures" (Lopes, 1992, p.18).

Interestingly, the findings of this study contradict conclusions made by Lopes (1992) regarding public perceptions and disaster images. Lopes found that while the use of disaster images helped enhance the recall of disaster preparedness presentations, they had a direct negative effect in encouraging the public to prepare for disasters ahead of time. One of the key distinctions between this research and that by Lopes is that in the latter not all of the respondents had previously experienced the disaster events that they were being surveyed on. Lopes also did not specify whether the disaster presentations featured local disaster images (i.e. so the respondents could personalize the threat) or if generic disaster images from other locations were utilized. Nevertheless as noted above, the unique case of the Red River Basin indicates that disaster images may influence public perceptions of flood risk and in some cases may also influence behaviour.

For comparative purposes, an issue statement regarding the visual presentation of the flood was also posed to Institutional Representatives (see section 4.3.4). While many respondents agreed that disaster images were an effective means to convince residents of the seriousness of the flood threat, some respondents questioned the action. This latter group of respondents noted that such action would not encourage preparedness and aid

response; they felt the use of disaster images would be counterproductive and cause undue fear and panic among the public. Similarly, other respondents perceive that this practice may mislead the public and cause them to overlook vital local information.

These perceptions indicate that further investigation of this issue would be of great benefit. Unless the Flood Area Residents reacted in a different fashion during the 1997 flood than they have expressed in this study, fear and panic were not dynamics that they noted as a response to the images from Grand Forks. Yet again, this is an issue that comes down to awareness from communication; if the Institutional Representatives had a greater understanding of local resident's perceptions of flood risk, then perhaps more of them would be aware of potential benefits from the visual presentation of flooding.

5.3.5 – The Effect of Large-Scale Structural Mitigation Measures

Another significant finding from the Delphi Process was the influence of large-scale structural mitigation measures on perceptions of flood risk in the Red River Basin (see sections 4.2.7 and 4.2.6). Rather than contributing to heightened perceptions and increased awareness like some of the previously identified factors, the overall influence of large-scale structural mitigation measures has been a reduction in perceived risk. This finding supports documentation in the literature (Dynes, 1970; Hewitt, 1983) that identified complacency and a false sense of security as perceptual shortcomings that often result from management practices that rely solely on structural measures.

Reliance primarily on structural measures has been a limitation of flood management practices in the basin, specifically within Winnipeg. Throughout the Delphi Process it was apparent that major flood control works, most notably the Floodway, have attenuated perceptions of flood risk among many Winnipeg respondents due to the

physical protection and sense of security they provide. For instance, while the 1979 and 1996 floods were sizeable events that caused notable disruption in the south region, the Floodway made these floods quite manageable and less significant in Winnipeg. In 1997, due to the benefits and reduction in risk provided by the Floodway, then-Mayor Susan Thompson declared that Winnipeg had won and that the flood was over while residents in the rural areas were still evacuated from their homes and fighting the floodwaters.

As alluded to in the above text, the influence of structural measures on perception is related to another influencing factor discussed previously – geographical variations in perception. An essential element in the influence of structural measures is the geographic location of the respondents; primarily Winnipeg respondents exhibited perceptions that were influenced by structural measures and very few South respondents expressed attenuated perceptions. This stands to reason given that the South respondents are not afforded large-scale structural protection to the same degree as Winnipeg respondents.

The Floodway and associated flood protection works have afforded the City of Winnipeg with a reduction in physical risk and this reduction appears to have created a great deal of complacency and a false sense of security among some City residents. This attenuation of flood risk may have significant implications for response behaviour in future floods. During the Delphi Process many Winnipeg respondents expressed a low level of perceived risk and indicated that if another flood were to occur in their lifetime, their response would be limited because the Floodway would keep them safe – thus creating situations in which they may be more vulnerable. Comments provided by some of the respondents illustrated that in 1997 they did not perceive the situation to be overly serious and they expected that the Floodway would protect the City like it had in the past.

I live inside the Floodway therefore I have a comfort level. If I lived outside the Floodway I'd probably have a different attitude. [Winnipeg respondent #08]

The potential was there in 1997, but because of the Floodway it was not a real flood like the 1950 flood was. [Winnipeg respondent #03]

Trusting in the temporary measures [in 1997] we moved nothing and suffered no losses. [Winnipeg respondent #11]

The above comments are noteworthy because they illustrate the effect the Floodway has on the perceptions of some Winnipeg residents. The first respondent perceives a level of comfort due the protection from the Floodway and recognizes that this comfort would not exist without the protection (i.e. structural protection has decreased the uncertainty). Interestingly, the second respondent did not consider the 1997 flood a "real flood" like the 1950 flood (at the time of the research the respondent still lived in the family home that had been flooded in 1950). This perception of 1997 being less serious is likely due to the fact that although the 1950 flood was lower in magnitude than the 1997 flood, without the Floodway in 1950 the impact on Winnipeg was significantly different than in 1997 when the physical risk was reduced.

The noteworthy facet of the third comment is the portion about not undertaking preventive behaviour. If the perceptions of many Winnipeg residents mirror those of the above respondent (i.e. decreased to the point where they do not undertake preventive measures), the possibility exists that if a flood exceeded the capacity of the flood control works these residents would be much more vulnerable and losses could be enormous. The danger of managing flood risk by using solely structural measures is that some residents may perceive the City to be risk-free and may not prepare for future floods.

If the Floodway had never been constructed, it is quite plausible that the attenuated perceptions and attitudes exhibited by some Winnipeg respondents would not

have existed. If Winnipeg residents had experienced the 1979, 1996, and 1997 floods like rural residents did, then it is likely that Winnipeggers would have significantly different perceptions of flood risk. In all probability, there would not have been such a notable divergence between the perceptions of Winnipeg and South respondents, as similar experiences would have established a similar heightened awareness of flood risk.

It is important to note that not all Winnipeg respondents exhibited attenuations in perception and a false sense of security. As noted previously, there are clearly locational differences in perception within the City. Some Winnipeg respondents expressed a heightened awareness of flood risk and noted that the benefits from the Floodway do not mean the City is risk-free. These respondents made reference to weaknesses in the Floodway Inlet and the possibility of flooding from the La Salle River in 1997 as reasons for their heightened perceptions. There was awareness in 1997 that the Floodway could fail and many respondents moved belongings out of their homes and put them into storage during the flood. Some noted that it was better to be prepared for the worst and hope for the best, rather than to not prepare at all and suffer devastating losses.

A federal-provincial partnership agreement on flood protection was implemented after 1997 and provided financial assistance to protect vulnerable neighbourhoods in the City (contingent upon local residents paying a portion of the cost). A small proportion of City respondents took the initiative and spent significant financial resources on mitigation measures to protect their property from flood levels equivalent to 1997. Respondents from areas of the City that were at high-risk during the 1997 flood, and narrowly avoided being flooded, were more sensitive to risk and indicated higher perceived risk and a greater willingness to adopt protective measures. Respondents living in neighbourhoods

that were at lower risk during the 1997 flood, and not as close to being flooded, indicated lower perceived risk and an unwillingness to adopt further flood protection measures. Respondents in these areas did not want to trade-off values such as aesthetics, lifestyle convenience, and economic cost-benefits in order to have enhanced flood protection.

Some of the Winnipeg respondents that expressed heightened awareness of flood risk due to their 1997 experience were concerned about the time that it is taking to begin construction and complete the Floodway Expansion project. These respondents noted that higher magnitude flooding may occur and the City and their homes are vulnerable until the Floodway is expanded. Nonetheless, many of these respondents qualified their heightened awareness with the notion that once the Floodway is expanded flooding in the City will be virtually eliminated and they will no longer have to be concerned. This finding suggests that the Floodway expansion may act to further attenuate or reduce City residents' perceptions of flood risk. The danger exists that not only will those residents who already have attenuated perceptions maintain their complacency, but some residents who currently perceive flood risk may also become complacent. Many of the respondents' comments detailed in sections 4.2.7 and 4.2.6 exemplify these perceptions.

The potential for further attenuation of flood risk parallels many of the attitudes that existed prior to the occurrence of the 1997 flood. Between 1979 and 1996 the City was not threatened by flooding due to the protection from the Floodway and many City residents perceived that they did not have to worry about flood risk because this was being controlled and managed by the government. The 1997 flood may have been beneficial because it convinced some residents that large floods which may exceed the capacity of the Floodway could occur and heightened their awareness and perception of

flood risk. A potential problem with the impending Floodway expansion is that this heightened awareness may be undermined and the false sense of security among City residents may be fostered. This is not creating a resilient population and is not a move towards sustainable flood management. If the expanded Floodway is ever exceeded or fails, it is likely that many City residents would be unprepared and more vulnerable.

> *I'm not concerned when I hear predictions, if I hear a 1997+2 level flood is coming I wouldn't move stuff out because it is not worthwhile ... I'll rely on flood protection measures like the Floodway.* [Winnipeg respondent #11]

5.4 – Summary

One of the key findings of the study is that many Flood Area Residents had an acute awareness of flood risk based on past experience. While most of the respondents did not comprehend the scientific theory behind the determination of objective risk, many displayed a general understanding of the factors that contribute to a flood threat and as such, perceived a close approximation of the real risk. The Delphi Process also established that when managing risk, institutional experts often rely on personal intuition and subjective influences similar to those that influence local residents' perceptions. While there is a degree of divergence between the perceptions of local residents and institutional representatives, the gap that does exist seems to be a result of shortcomings in communication where either side is not fully aware of the other's position.

The second half of the chapter detailed a number of factors that have influenced Flood Area Residents' perceptions of flood risk. Geographical location was one of the key influencing factors as at a large geographic scale there were notable differences in perception between Winnipeg and South respondents. Another of the central factors determining residents' perceptions of flood risk was past experience. All of the Flood

Area Residents in this study experienced the 1997 flood and many correspondingly expressed a heightened awareness of flood risk.

An imperative consideration for decision makers is that a lack of communication can increase uncertainty, which can then influence residents' perceptions of flood risk. This has occurred in areas upstream of the Floodway Inlet and south of the West Dike, where some respondents exhibited amplified perceptions of risk due to the uncertainty associated with the Floodway Expansion project. This uncertainty and lack of knowledge has also produced public opposition and led to increased stress for some respondents, as they perceive that their personal flood protection will be inadequate in future floods.

Based on the findings from the Delphi Process, the visual presentation of the flood was a significant influencing factor in some respondents' perceptions of flood risk in 1997. While some Institutional Representatives recognized the value in visually presenting the flood threat, others perceived that disaster images tend to instil panic and fear among the public. Another noteworthy finding was the influence of large-scale structural mitigation measures on perceptions of flood risk. In some cases the physical reduction in risk and sense of security provided by the Floodway has attenuated Winnipeg respondents' perceptions. Not all Winnipeg respondents exhibited attenuation, as some expressed heightened awareness and concern that the City remains vulnerable. However, many of these respondents noted that once the Floodway Expansion project is completed there will no longer be any reason to be concerned about flood risk.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 – Overview

The primary goal of this study was to examine flood risk perception and its role in decision-making in relation to hazard and disaster management in the Red River Basin. There were four specific objectives that the research intended to address. The first objective was to *assess the nature of perceived risk at both the local and organizational levels*. A survey of Flood Area Residents from within Winnipeg and from southern Manitoba provided the primary data used to examine perceptions at the local level. In addition, a survey of Institutional Representatives provided the primary data used to examine perceptions at the organizational level. The data were collected through the use of a Delphi Process, a modified version of a qualitative research method that involved preliminary face-to-face interviews followed by a two-round mail-out survey. A number of notable issues were identified with respect to perceived risk (outlined in Chapter 4).

The second objective of the research was to *determine if there is any variation between perceived risk among flood area residents and institutional experts*. As outlined in Chapter 5, findings from the Delphi Process indicated that the gap between residents' and experts' perceptions of flood risk was not as appreciably large as indicated by the literature. The gap that existed between residents and experts was related more to a lack of understanding fostered in part by shortcomings in communication.

The third objective of the research was to *identify various factors that influence perceptions of risk and decision-making processes at the local level*. The findings from Delphi Process distinguished past flood experience, uncertainty, visual presentation of the

flood, and large-scale structural mitigation measures as factors that influenced local residents' perceptions of flood risk. Another influencing factor that was identified, geographical variations in perception, was also the focus of the fourth objective of the study: *to examine the variations in flood area residents' perceptions of risk and flood-related issues based on their geographical location.* The research indicated that not only are there perceptual variations between rural (southern Manitoba) and urban (Winnipeg) regions, there are also perceptual variations within these regions.

Since this study was intended to provide an in-depth and reiterative examination of flood risk perception, the scope of the study was limited to a small sample size (i.e. 42 respondents). Accordingly, the outcomes that were established could not be used for generalizations applicable to all residents and institutional representatives in the basin. The generalizations that were made in this study were done utilizing qualitative inferences rather than using quantitative tools. It would be useful to conduct a larger investigation into flood risk perception using a larger sample size and quantitative tools so that broader generalizations and direct correlations could be made.

Another limitation of this study was the geographic scope, which was limited to Winnipeg and southern Manitoba. In a larger study, residents living north of Winnipeg in the Selkirk and Breezy Point areas would be included. Residents in these regions face significant risk from ice-jam flooding and their perceptions need to be considered. In addition, since this research was conducted six years after the 1997 flood the possibility exists that some memories could have faded and may not have been as detailed as they were closer to 1997. Conclusions from the findings of the study and recommendations for further research and practical application are presented in this chapter.

6.2 – Implications from the Existing Gap in Communication

A lesson learned from the 1997 flood event was that a top-down or command-and-control approach to decision-making is not effective because it provides little opportunity for the inclusion of social (human) aspects. As was noted by the International Red River Basin Task Force after the 1997 flood, more research is needed to fully understand the immediate and long-term social effects of flooding on residents in the Red River Basin (IJC, 2000a). The International Joint Commission supported this observation and recommended that governments in the basin support research into the social dimensions of flooding in order to improve the resiliency of the residents (IJC, 2000b). As such, one of the intentions of this study was to provide information that could improve the understanding of one pivotal human element – the perception of flood risk.

An important step in improving the comprehension of social aspects is to investigate the perceptions of risk that local residents apply to personal decision-making processes. In addition, it is also important to investigate the perceptions of institutional experts who make the decisions that affect residents. As was illustrated by the significant psychosocial impacts that resulted from the 1997 flood – if those responsible for managing disaster situations are not aware of how residents perceive risk, efforts aimed at reducing risk and vulnerability at the local level are less likely to be successful.

This study found that while a gap does appear to exist between Flood Area Residents and Institutional Representatives, it does not stem from a significant difference in their perceptions and awareness of flood risk. Many Flood Area Residents indicated that at the local level there is an experientially derived awareness of the physical factors that contribute to flood risk and a general understanding that large floods similar to 1997

will recur. Responses from Institutional Representatives indicated that an element of subjectivity is often involved with decision-making processes. While the calculation of objective risk is straightforward for experts (i.e. risk assessment), when it comes to the implementation of policies and procedures (i.e. risk management) a degree of subjectivity can be introduced when uncertainties arise and experts need to go beyond written plans.

The gap that does exist between Flood Area Residents and Institutional Representatives can be attributed in part to deficient communication. Many Flood Area Residents from southern Manitoba perceive that institutional experts have very narrow viewpoints because they live in Winnipeg. Alternatively, some Institutional Representatives feel that residents do not accurately perceive flood risk and therefore, are not aware of the real risk. Clearly, both sides have misconceptions with respect to the perceptions of the other that have developed due to a lack of meaningful communication. As the research indicated, while most Flood Area Residents may not comprehend the precise statistics involved in risk calculations, many have a general understanding of objective risk. Alternatively, many Institutional Representatives have an awareness of local issues and concerns, but not a detailed understanding of local perceptions.

A potential outcome of this communication gap may be increased difficulty in the delivery of services during the next flood. For instance, a very contentious issue during the 1997 flood was mandatory evacuation and many Flood Area Residents expressed that in the next flood they will defy mandatory evacuation in order to protect their homes. An Institutional Representative pointed out that the evacuation policy has been changed since 1997 to reflect this desire to remain behind to protect property. Herein, the problem appears to be that the policy change has not been communicated to residents, as none of

the study participants were aware of the new guidelines. As a result, emergency response personnel may have difficulty executing an evacuation in the next flood because they will also have to explain the guidelines to residents – during an emergency there is little time for discussion and due to the resentment harboured by residents, many may not listen.

A potential solution may be a two-way communication process involving personal meetings, educational materials, informal workshops, and other means to disseminate flood-related information and to receive resident's feedback. "Responsible agencies need to develop communication channels with the public that provide for interaction, and they must be prepared to provide the general public with the information they require, as and when it is needed" (Gough, 1998, p.121). Any communication problems or concerns could be addressed through a program during non-emergency times and given the due attention that would not be possible during the constrained timelines of an emergency.

Full-time, government-funded community liaisons could oversee programs and create communication links between all levels of government and local residents. "Two important objectives common to most risk communication frameworks or programmes are the establishment of communication channels that may also be used to transmit non-risk information, and the development of trust between interested parties" (Gough, 1998, p.121). Developing and establishing communication channels during non-emergency times could markedly improve the transfer of information during an emergency event and enhance the response – thus reducing the impact on the residents and the institutions.

6.3 – Implications from the Factors Influencing Flood Risk Perception

This study identified some of the key factors that influence Flood Area Residents' perceptions of flood risk in the Red River Basin. Research findings indicated that the

respondents' perceptions of flood risk varied based on their geographical location. Differences were noted between Winnipeg and South respondents and also within both of these groups. Past flood experience was identified as another factor that influenced perceptions of risk. Experience with past floods may reduce future vulnerability by decreasing uncertainty and making residents more knowledgeable and prepared. In some cases respondents with past experience exhibited a heightened awareness of flood risk and indicated that the 1997 flood experience will serve as a key reference point for estimating perceptions of risk and subsequent behaviour in future flood events.

Uncertainty associated with a lack of communication also influenced respondents' perceptions of risk. A number of respondents exhibited amplified perceptions of risk and opposition to the Floodway Expansion project due to the uncertainty that has resulted from a lack of information on the project and its potential effects in rural areas. Another key factor that influenced perceptions of risk in 1997 was the use of disaster images to convey the severity of the flood threat. Many respondents noted that in 1997 a key element that convinced them of the seriousness of the flood threat was viewing images from the Grand Forks disaster. This visual presentation of the flood allowed them to personalize the risk and in some instances influenced their behaviour.

The factor most likely to have significant implications for decision-making is the influence of large-scale structural mitigation measures. One of the results of the continued practice of reactive hazard and disaster management and a reliance on large-scale structural measures is a potential increase in the vulnerability of some residents. When "we build dams and levees, we give people the illusion that the problem has been conquered whereas, in fact ... [t]he danger of flood damage increases despite flood

control because people have confidence in the works themselves, which leads them to build out over the floodplain" (Dynes, 1970, p.81). By not accounting for perceptions of risk in decision-making processes, management strategies have influenced the perceptions of some residents. Residents' perceptions have developed in the context of a reactive, event-driven management ethos focused on large-scale structural measures.

The product of this context has been attenuation of risk in some areas and amplification of risk in others that has subsequently increased vulnerability throughout the basin. This management approach does lead to sustainability and has made the population less resilient – exemplified by the significant psychosocial impacts that occurred in the south region due to the 1997 flood and the remaining level of vulnerability. Despite the recognition of these past shortcomings, future management may be more difficult because of this context that perceptions have been formulated in. These perceptions will be the perspective within which new strategies and policies are viewed and will contribute to the behaviour of local residents in future flood events.

Based on the nature of responses from South and Winnipeg respondents and their physical locations, it was clear that the levels of risk they face – and subsequently their perceptions – are somewhat different. A primary distinction for South respondents living on rural homesteads in the basin is that flood events represent a very uncertain time for them. South respondents noted that they largely fought the 1997 flood as individuals and some encountered problems with information communication, access to resources, and management procedures. The majority of South respondents did not describe the 1997 flood as a positive experience. Alternatively, most Winnipeg respondents provided different accounts of the 1997 flood, many of which were positive. These respondents

noted that fighting the 1997 flood in the City was a collaborative effort with effective communication, good access to resources, and assistance from volunteers and City staff.

The integral factor influencing the perceptions of Winnipeg respondents has been the role of large-scale structural measures. The existence and operation of the Floodway alters the physical risk in Winnipeg so that natural flood conditions do not occur within the City. The type of flooding exhibited in Winnipeg cannot be considered natural because control structures regulate the floodwaters and the Province has the ability to physically manipulate water levels within the City. The primary difference for Winnipeg residents in comparison to South residents is that the former are experiencing controlled water levels that have much more certainty – which can often reduce stress.

The problem with this certainty is the complacency that it breeds. Flood control works afford Winnipeg residents with a reduction in physical risk and a level of protection that has produced an increasingly complacent population. The fact that Winnipeg has not flooded since the 1950 flood has impacted perceptions of flood risk in the City. The 1996 flood was equal in magnitude to the 1950 flood, yet due to the existence of the Floodway it was barely a noticeable event because it did not cause the destruction that floodwaters had in 1950. Many Winnipeg respondents specified that prior to 1997 they had become complacent and did not perceive flood risk, as they assumed that the Floodway would protect them from flooding and that someone else was dealing with the threat. Some respondents noted that neighbours had cut holes in or torn down backyard dikes to gain a better view of the river. "[M]any residents were anxious [in 1997], not knowing if they were protected by the primary dike" (McNeil, 2000, p.60).

Even during the 1997 flood, which was larger than the 1950 flood, aside from the homeowners living on or near the Red River, day-to-day life in the City was not disrupted as it had been in 1950. One respondent encapsulated this attenuation rather succinctly in the Delphi Process by stating that the 1997 flood was not a real flood like the 1950 flood. The Floodway had attenuated perceptions to the degree that many Winnipeg residents greatly underestimated the risk. The result was a population that greatly underestimated the flood risk and was therefore quite vulnerable. The Manitoba Water Commission (MWC, 1998) noted that if there had been a significant rainfall event in 1997, flood levels could have approached those of the flood of record (1826) and would have inundated much of Winnipeg. Damages would have been in the billions of dollars due to the fact that the population was unprepared and accordingly vulnerable.

All of the Winnipeg respondents in the study did not exhibit complacency and a low awareness of risk, as some were very aware and well articulated on flood-related issues. Some respondents also noted that the occurrence of the 1997 flood heightened their awareness of flood risk. In spite of this, a pattern that emerged among many respondents was the notion that Floodway expansion will eliminate the threat from future flooding. It is quite plausible that Floodway expansion will further attenuate perceptions and some residents who currently perceive risk may adjust their perceptions and consider the City to be risk-free. Such a perceptual feature could create complacency, which may lead to a more vulnerable and less resilient population that contributes to increased disaster losses in flood events that exceed the capacity of flood control works.

The overall result of this reactive management style is that the risk for the City is being compounded. At some point, significant devastation may occur because managers

are trying to control flood risk, rather than being adaptive and learning to live with the risk and preparing residents in order to reduce their vulnerability. An outcome of strictly regulated water levels is that some Winnipeg respondents underestimate flood risk and have not adopted flood protection under the assumption that the Floodway will protect them. These respondents are dependent on the structural protection and certainty the City provides so that they can consciously ignore or deny the real risk. These respondents are not facing a true level of risk because the situation in the City is so controlled and as a result, they may be increasingly vulnerable to floods that exceed the design capacity of the structural measures. These feelings of security only stand to be enhanced as many Winnipeg respondents perceive that Floodway expansion will eliminate the flood risk for the City. "Long-term vulnerability increases when risk is transferred from the more frequent low-impact events to the rarer high-impact events" (Etkin, 1999, p.70).

This is not meant to be an argument with respect to expanding the Floodway, as based on the real risk this is necessary to protect the City. However, there is a need for education to accompany the project to help City residents become more aware and less vulnerable in the event that an emergency occurs. For example, if residents are prepared then they are more likely to be resilient and losses would be reduced in a situation where the Floodway was exceeded or failed. With a good preparedness program residents could be on alert during a large flood and if something detrimental were to occur, preparedness plans could be implemented and residents would have awareness and knowledge that would help guide their behaviour – thus making them less vulnerable and more resilient.

Nonetheless, in Winnipeg the actions of planners and municipal officials since 1997 indicates that risk perception and vulnerability are not taken into account in their

decision-making. In Grand Forks, North Dakota efforts were made to prevent rebuilding along the Red River after the 1997 flood. Rather than rebuild structures in vulnerable areas, the riverbanks were converted into parkland and greenways. Similar sustainable management practices have not been implemented in Winnipeg; in fact, the opposite has been done. Since the 1997 flood the City has funnelled large sums of money into a development project called 'Waterfront Drive' along the banks of the Red River.

> The Red River's west bank will never be the same. Tens of millions of dollars worth of hospitality and residential construction is expected to take shape on Waterfront Drive this year after a request for proposals was issued ... CentreVenture Development Corp. says it has already fielded numerous inquiries from developers who see the new $9.1-million Waterfront strip as the 'Peg's next boom zone. The municipal corporation expects bids for projects worth up to $30 million to come quickly (Romaniuk, 2004).

From a risk management standpoint it does not seem prudent to promote further development in a high-risk flood zone. Upon completion of the Waterfront Drive project more than $40 million in infrastructure will be at risk from flooding along the banks of the Red. While the Waterfront Drive project is important to the local economy, any riverbank development needs to be considered in light of a sustainable framework. Floodway expansion will provide additional protection but this protection is not absolute.

The key is to find a balance between structural and non-structural mitigation measures to ensure that the population perceives the real risk and is prepared to deal with uncertainties that arise. A prepared population that perceives risk realistically is more resilient and better able to cope because the residents will have a higher disaster threshold than a population that is reliant solely on structural measures. A community with a higher disaster threshold will be better able to manage high magnitude impacts (e.g. if flood control works were exceeded). An unprepared community will have less ability to

cope and a lower disaster threshold – meaning that the community has a lesser chance of effectively managing high magnitude impacts. Essentially, the disaster threshold is increased in communities that perceive risk and have implemented preparedness programs that include both structural and non-structural measures. In communities where proactive preparedness programs are not undertaken (e.g. sole reliance on structural measures), the outcome can be much worse when the disaster threshold is exceeded.

6.4 – Implications from the 1997 Flood Experience

Despite the shortcomings that were identified in this study, a number of findings illustrated that lessons learned from the 1997 flood event have produced constructive outcomes for hazard and disaster management. Prior to 1997 many institutional organizations had grown complacent and flood-related issues were low priorities, despite the noteworthy existence of a significant level of objective risk. Many institutional experts had retired and taken with them valuable experiential knowledge gained during past events, including the 1979 flood. Even though a flood equivalent in magnitude to the 1950 flood had occurred in 1996, many organizations were not prepared in 1997. Retired workers had to be rehired or called back voluntarily to share information and aid the decision-making process, much of which became reactive and ad-hoc in nature.

From an institutional perspective, the characteristic of complacency appears to have been a lesson learned from the 1997 experience. Study respondents noted that even six years after 1997, flooding remains an important element in the day-to-day operations of many organizations. Due to the 1997 experience, many respondents noted that their organizations have recognized the limitations of operating in a reactive and ad-hoc manner. One respondent noted that since 1997 his organization has been mandated to

deal with flood-related issues and digitizing all of its flood information so that resources are easily accessible in the future. Another organization hired a staff person to coordinate internal disaster management planning. There has been a great deal of documentation on the 1997 flood and knowledge of flooding in the basin has been significantly enhanced. Study respondents indicated that policies have been formulated to enhance the response capabilities for future floods and attempts are being made to be more proactive.

Another notable strategy is the use of the 1997 flood as a benchmark to communicate risk levels to residents. Some Institutional Representatives noted that the benchmark method is a useful way for managers to explain flood risk in non-technical terms so that residents will understand. This method is an effective means for conveying the flood threat, as it will allow residents to personalize the risk and visualize their particular case. Many Flood Area Residents pointed out physical reference points on their home or property that illustrated the risk levels from the 1997 flood. One particular respondent still had plastic markings nailed onto hydro poles that depicted the level of 1997 floodwaters and others had stakes or posts in their yards that signified flood levels.

Despite increased attention to broader flood-related issues, overall hazard and disaster management decision-making appears to have remained focused primarily on structural mitigation measures that are derived from political and economic criteria. While a number of Institutional Representatives recognized the benefits of including basic social aspects in management practices, very few indicated that meaningful attempts have been made to implement them into actual decision-making. Steps have been taken towards establishing more proactive and sustainable management practices, but the organizations have not attempted to establish two-way communication processes

aimed at building relationships with residents and fostering opportunities for learning on both sides. "Effective risk communication is a two-way process aimed at establishing common ground between interested parties and developing trust in relationships between groups that will improve the credibility of decisions and enhance the prospects of compromise solutions being achieved" (Gough, 1998, p.113).

6.5 – Recommendations for Research and Practice

This study provided an examination of a subject area in which there has been limited investigation to date in the Red River Basin. Since this was a small-scale research study with a small sample size, none of the findings presented in this study can be generalized to represent the perceptions of all residents or institutional representatives. Nonetheless, the findings do offer some insights that could be investigated further by future research including a larger more statistically significant sample of participants. Potential directions for future research are considered briefly below.

1) *One notable research finding was that respondents in areas of Winnipeg that were at high-risk in 1997 seemed more willing to adopt further flood protection. This is an area in which further research could be conducted to examine correlations between perceptions of risk and threat levels and also with the willingness to adopt and pay for further flood protection measures.*

2) *Many study respondents indicated that viewing the Grand Forks disaster in 1997 convinced them of the gravity of the risk and in some cases influenced preventive behaviour. Further research is required to examine direct correlations between disaster images, perceptions of risk, and subsequent preventive behaviour.*

3) *Related to recommendation #2, there is also a need to investigate the issue further at an institutional level to evaluate potential use in emergency management. Some Institutional Representatives felt that visual presentation of flooding causes fear and panic among the public. Further research is required to determine the effectiveness or limitations of using such methods.*

4) *The research identified a difference within the south region between residents in ring dike communities and residents on homesteads or farms. Further research could compare the perceptions of these rural residents and examine potential*

variations. It may be of merit to investigate the influence of community ring dikes (i.e. a structural mitigation measure) on residents' perceptions of flood risk.

5) *The features of the Delphi Process (i.e. anonymity, iteration, and controlled feedback) indicated that the technique might be useful for educational purposes. Future research in the basin could explore the possible means for using the Delphi Process as a tool to disseminate information and to receive feedback.*

In addition, the findings from this study generated implications for institutional experts in the basin and demonstrated the importance of including flood risk perception in decision-making processes. Implementation of the following recommendations could significantly improve hazard and disaster management.

1) *The 1997 flood should continue to be used as a benchmark or reference point for explaining flood probability and communicating levels of flood risk, rather than using statistical figures. Communications also need to point out that no two floods will be the exact same, i.e. a rainfall event could make a 1997 level flood higher and flow patterns may be altered based on landscape changes since 1997.*

2) *A government led monitoring and evaluation program needs to be set up for individual homeowners' dikes and floodpads to ensure that they are still at the minimum flood protection level of 1997+2 feet. Settlement could decrease flood protection levels and individual homeowners will be more vulnerable if flood protection has settled over time to a level lower than it is presumed to be.*

3) *The visual presentation of flooding from upstream regions in the United States, via the television and print media, should continue to be used to convince residents of the seriousness of flood situations. Some residents become complacent and it may take disaster images and/or visual proof of high water levels to convince them to perceive and personalize flood risk.*

4) *The 1997 flood had significant psychosocial impacts, one of which was extreme stress for many South respondents. The current lack of communication could potentially create further psychosocial impacts in future floods by increasing local uncertainty. Uncertainty is created by a lack of information and can lead to amplified perceptions of risk, increased levels of stress, and public opposition. As such, an improved communication system needs to be implemented in the basin and additional resources need to be dedicated to communicating risk to residents.*

5) *Improved communication will also help bridge gaps in understanding between residents and experts. The key is utilizing two-way communication in which information is exchanged both ways and meaningful dialogue is created. Government-funded community liaisons could help achieve such a vision. Policy*

changes (e.g. evacuation guidelines) need to be communicated to all residents who will be affected and their expediency can be gauged through dialogue.

6) *More Provincial resources need to be provided in southern Manitoba to improve emergency preparedness and flood response. Winnipeg residents are afforded the best physical protection and access to significant amounts of resources and these inequities with the rural residents of the basin need to be addressed.*

7) *An education program needs to be undertaken within Winnipeg to improve the awareness of flood risk. This study found that large-scale mitigation structural measures have attenuated perceptions of flood risk and further projects may potentially compound this complacency and create more vulnerable residents. This vulnerability needs to be addressed through preparedness programs so that the population will be more resilient in the event that flood protection is exceeded.*

8) *There needs to be a commitment from political leaders to provide resources for hazard and disaster management that goes beyond four-year political cycles. Simultaneously, there is also a need to develop proactive and sustainable mitigation and preparedness programs that are intended to reduce the levels of risk and vulnerability for current and future residents of the basin. Reliance on reactive management has proven to be an unsustainable practice.*

6.6 – Concluding Remarks

The activities and actions undertaken prior to the occurrence of a disaster event (i.e. mitigation and preparedness) are intended to reduce the impact on a community during and after the occurrence of a disaster (i.e. response and recovery). One of the keys to establishing successful mitigation and preparedness strategies that reduce the impacts during response and recovery is comprehension of the social aspects present at the community level. Without accounting for social aspects, particularly perceptual characteristics at the local level, mitigation and emergency response strategies cannot be fully effective. An important part of this comprehension is awareness of how the local residents that will be affected by the programs and policies perceive flood risk. Hazard and disaster management prior to and during the 1997 flood event in the Red River Basin

largely did not account for the perceptions and views of local residents. As a result, there were significant adverse psychosocial impacts on many of these residents.

This study exemplified the nature of flood risk perception in the Red River Basin and potential implications for hazard and disaster management decision-making. "Psychometric knowledge may not ensure wise or effective decisions, but [a] lack of such knowledge certainly increases the probability that well-intentioned policies will fail to meet their goals" (Slovic et al., 1982b, p.89). Since some of the factors that influence perception and vulnerability are interrelated, an analysis of perception can also indicate the vulnerability of local residents. When equipped with this knowledge, hazard and disaster management decision makers can develop proactive programs and policies that address perceptions and are intended to reduce vulnerability and increase the resilience of local residents. Therefore, more resources and effort needs to be focused on including local residents' perceptions and awareness of risk in the decision-making process.

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APPENDIX 1: Key Steps in the Framework of a Delphi Process

1. *Develop the Delphi Question* – This initial step is the integral component in the Delphi process and must be done as clearly and accurately as possible. If the broad question that is the focus of a Delphi study is not clear, respondents may answer inappropriately or become frustrated and lose interest in participating. The design team must ensure that time and care have been spent formulating the question; those who will utilize the information from the Delphi study must be consulted to ensure the question will serve their purposes (Delbecq et al., 1975).

2. *Select and Contact Respondents* – Effective participation can only be obtained from respondents who: a) feel personally involved in the issue of concern, b) have pertinent information to share, c) are motivated to complete the Delphi amidst all their other duties, and d) feel that an aggregation of respondent panel judgments will include information that they value and would not have otherwise been subject to (Delbecq et al., 1975). A nomination process can be used to select specific respondents who may possess relevant information or experience regarding the objectives of the study.

   Richey et al. (1985) outlined a framework for determining the extent to which potential respondents meet predetermined criteria. In their study, Richey et al. (1985) identified 105 potential Delphi panellists and sent each of them invitation letters that detailed the project objectives, requested that the person join their panel, and included a consent postcard that was to be returned with an indication of willingness or unwillingness to participate. "Following receipt of the consent postcard, all willing candidates received the Pre-Delphi Survey (PDS) that questioned them about the selection criteria and the amount of time they would be willing to donate" (Richey et al., 1985, p.139). Richey et al. (1985) cited different means for convincing the candidates to participate: the use of an individual with high prestige to make the invitation, hope that the matter of concern is of high enough interest to warrant participation, or the use of monetary compensation as a reward for participation.

   It is essential to ensure that potential respondents be convinced of the importance of the Delphi's objectives and the importance of their participation. An alternative to the innovative framework utilized by Richey et al. for engaging participation could include the use of telephone calls or face-to-face contact that outline: the objectives of the study, the nature of the respondent group, the respondent's obligations, the length of time required, and the information that will be shared among respondents (Delbecq et al., 1975). Richey et al. (1985) concluded that, "participation in a Pre-Delphi Survey did not have any apparent influence on whether a participant was likely to continue, although such participation had slightly increased the likelihood that an invited individual would agree to join the panel in the first place" (p.140).

3. *Select Sample Size* – The size of the respondent group depends on the needs of the researcher and the type of group that is involved. According to Delbecq et al. (1975), for homogeneous groups between ten and thirty participants are sufficient, any larger of a group would not generate enough new ideas to be worthy of the time and effort spent. On the other hand, for more heterogeneous groups with many different interests, several hundred participants may be involved.

4. *Develop Questionnaire #1 and Test* – According to Delbecq et al. (1975), when Delphi is being used as a pilot research instrument the purpose of the first questionnaire is to allow participants to provide responses to a broad problem. When Delphi is being used in studies where the variables are already developed, the first questionnaire can be more specifically aimed at the refinement of issues (Delbecq et al., 1975). A crucial component of the Delphi technique is the cover letter that accompanies the questionnaire. The cover letter must be well prepared and include the following: thanks to the individual for their participation, an explanation of why the individual's opinion is being sought, an explanation of how the results of the Delphi will be utilized, and any necessary instructions, as well as a response date (Delbecq et al., 1975). Delbecq et al. (1975) provided some important factors and suggestions that can guide the development of a successful questionnaire:

    i. ensure there are no technical errors in both documents, especially the spelling of the respondents names;
    ii. make the cover letter no longer than one page in length;
    iii. ensure that the task instructions are clear;
    iv. simplify questionnaire return by including a self-addressed, stamped envelope;
    v. send out the questionnaire as soon as a person has agreed to participate, delays will result in a loss of enthusiasm for the project and may portray an image of insincerity; and
    vi. make a specific deadline (say two weeks) for questionnaire return (p.93).

    Delbecq et al. (1975) also noted that some participants may require further encouragement to return questionnaires. A "dunning letter" may be sent out one week after the first questionnaire was sent to serve as a reminder of the deadline and should provide a collect telephone number to address any questions. A phone call by members of the work group may also serve this purpose.

5. *Analysis of Questionnaire #1* – According to Delbecq et al. (1975), the analysis of the returned questionnaires should produce a summary listing of each response and any additional comments made for a given question. There are various methods that a research team can apply in this step – in some cases pen and paper are sufficient or when financial resources permit, computer programs can be used to analyze the data and perform statistical operations. Delphi studies conducted online or that are computer-based can eliminate the delays that are associated with summation by hand.

6. *Develop Questionnaire #2 and Test* – The primary objective of the second questionnaire is to accurately convey the meaning that respondents expressed in their answers to the first questionnaire (Delbecq et al., 1975). The second questionnaire asks respondents to review each of the items identified in the first questionnaire; noting items for agreement or disagreement, providing clarification on items that may not be expressing the desired point, and preliminary ranking of the items for the

determination of emerging priorities (Delbecq et al., 1975). Delbecq et al. (1975) identified four format issues that must be addressed in the second questionnaire:

i. items from the first questionnaire should be identifiable and understandable;
ii. comments of agreement, disagreement, or clarification should be added;
iii. ranking instructions should be clear and discernable; and
iv. the questionnaire must be short, requiring 20 to 30 minutes for completion.

7. *Analysis of Questionnaire #2* – Analysis of the second questionnaire depends on the goals of the research team and the previous analyses they have employed. Delbecq et al. (1975) noted that the analysis should include a total of the rank received for each item and a summary of the comments made by the respondents. Before moving to the next step, the research team must determine if the respondents have provided information that meets the intended goals of the project. If the information is insufficient the research team can change the third questionnaire to reflect the intended goals and continue iterations until the desired goal is reached (Delbecq et al., 1975). If the information that has been gathered is adequate, the research team can end the study after two rounds; a number of studies (see de Loe 1995; de Loe and Wojtanowski, 2001) typically involve only two rounds. The endpoint for a Delphi can be based upon a variety of factors: project objectives and goals, time constraints, budget constraints, prescribed statistical ranges, points of diminishing returns, or stability of responses (Bardecki, 2002; Chaffin and Talley, 1980).

8. *Final Analysis and Preparation of Final Report* – Delbecq et al. (1975) intended for the final report to serve as not only the final outcome of the project for the research team, but also as an information dissemination and feedback tool for the respondents. "A final report should summarize the goals and the process as well as the results" (Delbecq et al., 1975, p.105). It is imperative that respondents receive a summary of the study for the purpose of closure and to show appreciation for their hard work and effort.

Source: Adapted from Delbecq et al. (1975).

APPENDIX 2: Request for Participation Letter – Winnipeg Respondents

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

To: Residents of the City of Winnipeg

May 6, 2003

Dear Sir or Madame,

We are team members of a research project entitled the Flood Research Partnership: Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin and Master's students at the Natural Resources Institute, University of Manitoba. The primary purpose of our research project is to explore the nature of flood-risk perception at the individual, community and institutional levels and the factors affecting risk communication among stakeholders.

We are looking to survey City of Winnipeg residents who have past experience with floodplain management issues, i.e. fought the 1997 or previous floods. We would like to invite an adult member of your household to participate, as a respondent, in the interview and surveys of this research project. With your generous assistance our research team will gain valuable insights into perceptions of floodplain management from a City of Winnipeg perspective. Your participation is voluntary and greatly appreciated.

Our research will involve one personal (face-to-face) interview and three written responses to mail-out questionnaires. The approximate time commitment for you will consist of one hour for the face-to-face interview and one hour for each of the written responses to the surveys (for a total of four hours). This four-hour commitment will be spread out over a three-month period. As a token of our gratitude for your participation, we will provide you with a cheque for $50.00 upon completion of all four parts of the study. All of the information that you provide will be kept in strict confidence and only aggregate (grouped) data will be utilized. Your name and information that you provide will remain anonymous and confidential.

Please detach and submit the form below indicating your willingness to participate in the study by May 31, 2003. Please check the appropriate box, fill out the appropriate contact information, and use the self-addressed, postage paid envelope to return your response. If you have any questions please leave a message for Mike Olczyk and Nancy Powell, Graduate Researchers, Natural Resources Institute, University of Manitoba at 474-8954 and we will contact you as soon as possible.

Thank you for taking the time to consider our request; we look forward to hearing from you.

Sincerely,

Michael Olczyk and Nancy Powell

✂----------✂

(Please detach and return in enclosed envelope – postage paid)

Name: _____

Address: _____ Postal Code: _____

Phone: _____

Willingness to Participate (please check one): ☐ Yes ☐ No

Convenient time for researchers to contact you: _____ daytime _____ evening

APPENDIX 3: Request for Participation Letter – South Respondents

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

To: Residents of the Rural Municipality of *(Insert Specific RM)*

July 23, 2003

Dear Sir or Madame,

I am a team member of a research project entitled the Flood Research Partnership: Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin and a Master's student at the Natural Resources Institute, University of Manitoba. The primary purpose of our research project is to explore the nature of flood-risk perception at the individual, community and institutional levels and the factors affecting risk communication among stakeholders.

We are looking to survey rural Manitoba residents who have past experience with floodplain management issues, i.e. fought the 1997 or previous floods. We would like to invite an adult member of your household to participate, as a respondent, in the interview and surveys of this research project. With your generous assistance our research team will gain valuable insights into perceptions of floodplain management from a rural Manitoba perspective. Your participation is voluntary and greatly appreciated.

Our research will involve one personal (face-to-face) interview and two written responses to mail-out questionnaires. The approximate time commitment for you will consist of one hour for the face-to-face interview and one hour for each of the written responses to the surveys (for a total of three hours). This three-hour commitment will be spread out over a three-month period. As a token of our gratitude for your participation, we will provide you with a cheque for $50.00 upon completion of all three parts of the study. All of the information that you provide will be kept in strict confidence and only aggregate (grouped) data will be utilized. Your name and information that you provide will remain anonymous and confidential.

If you are interested and would be willing to participate in our study we would appreciate that you call us to confirm your interest and we will return your call as soon as possible. We would kindly ask that those who choose to contact us do so before August 7th, 2003 so that we can begin arranging interviews. Please call and leave a message including your appropriate contact information for Mike Olczyk, Graduate Researcher, Natural Resources Institute, University of Manitoba at 474-8954 and I will contact you as soon as possible.

Thank you for taking the time to consider our request; I look forward to hearing from you.

Sincerely,

Michael Olczyk

APPENDIX 4: Introductory Letter (Phase One of the Delphi Process)

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

INTRODUCTORY STATEMENT

My name is Mike Olczyk I am a student at the Natural Resources Institute, University of Manitoba.

The purpose of our research is to enhance the understanding of community processes and better communication among floodplain stakeholders. We want to explore these issues through interviews with community members. The objectives of the study are to:

1) Assess the nature of flood risk perception at individual and community levels.
2) Determine the nature and factors of risk communication among the stakeholders and other factors affecting communication with various floodplain management issues.
3) Explore the role of partnership development in sustainable floodplain management.

Each participant was chosen to participate in this study based on a geographical distribution of households in the Red River Basin. Individuals were randomly selected from lists derived by Rural Municipal Council Offices regarding past flood experience.

The research will require an initial approximately one-hour interview that will be followed by three subsequent mail-out questionnaires, each requiring approximately one hour for completion. The first questionnaire will be mailed out approximately two months after the face-to-face to interviews. There will be an approximately one-month interval between subsequent questionnaire mail-outs. The research will explore issues relating to your experience, perception, knowledge, and decision-making involvement with past floods and associated floodplain resources. The content will cover a wide range of topics including public policy implications, emergency management, and future flood preparation and response.

You are under no obligation to participate in the interviews. If you choose to participate please feel free to discuss your opinions openly and freely. You can, at any time, end the interview or refuse to answer individual questions. In the event that you do not wish to answer a specific question, simply respond "no comment". If you permit, to ensure accurate representation of your responses we would like to use a tape recording device. You are under no obligation to be recorded and may refuse. Your responses will be held in strict confidence and the results of the study will be aggregated (grouped) with no reference made to specific participants. Upon completion of all four components of the study, you will receive a monetary sum as compensation for your participation.

The research is a component of a larger project titled the Flood Research Partnership: Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin and is funded by the Social Sciences and Humanities Research Council (SSHRC) through a 3 year Community-University Research Alliance (CURA) grant. The FRP project involves researchers from various institutions working together in partnership with communities to develop best practices for sustainable floodplain management.

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact the Human Ethics Secretariat at 474-7122 or Dr. C. Emdad Haque, Director, Natural Resources Institute at 474-6395.

APPENDIX 5: Informed Consent Form (Phase One of the Delphi Process)

INFORMED CONSENT TO PARTICIPATE IN THE STUDY

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of our research is to enhance the understanding of community processes and better communication among floodplain stakeholders. We want to explore these issues through interviews with community members. The objectives of the study are to: 1) assess the nature of flood risk perception at individual and community levels, 2) determine the nature and factors of risk communication among the stakeholders and other factors affecting communication dealing with various floodplain management issues, and 3) explore the role of partnership development in sustainable floodplain management.

The research is a component of a larger project titled the Flood Research Partnership: Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin and is funded by the Social Sciences and Humanities Research Council (SSHRC) through a 3 year Community-University Research Alliance (CURA) grant. The FRP project involves researchers from various institutions working together in partnership with communities to develop best practices for sustainable floodplain management.

The research will require an initial approximately one-hour interview that will be followed by three subsequent mail-out questionnaires, each requiring approximately one hour for completion. The research will explore issues relating to your experience, perception, knowledge, and decision-making involvement with past floods and associated floodplain resources. The content will cover a wide range of topics including public policy implications, emergency management, and future flood preparation and response.

You are under no obligation to participate in the interviews. If you choose to participate please feel free to discuss your opinions openly and freely. You can, at any time, end the interview or refuse to answer individual questions. In the event that you do not wish to answer a specific question, simply respond "no comment". To ensure accurate representation of your responses a tape recording device will be utilized during the interview. You are under no obligation to be recorded and may refuse. Your responses will be held in strict confidence and the results of the study will be aggregated (grouped) with no reference made to specific participants. It is our desire that you, the participant of the study, be informed of our findings. If you would like a summary of the survey findings please inform the interviewer and they will record your name and mailing address so we can mail the summary to you. Upon completion of all four components of the study, you will receive a monetary sum as compensation for your participation.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Michael Olczyk and Nancy Powell, Graduate Researchers, Natural Resources Institute (204-474-8954), or Dr. Emdad Haque, Director, Natural Resources Institute (204-474-6395).

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at 474-7122. A copy of this consent form has been given to you to keep for your records and reference.

Signature of the Respondent _____ Date _____

Signature of the Interviewer _____ Date _____

APPENDIX 6: Face-to-Face Interview Instrument for Flood Area Residents (Phase One of the Delphi Process)

CURA Flood Research Partnership – Risk Management Component

Delphi Phase One: Face-to-Face Interviews – ***Flood Area Resident Instrument***

Part 1: Idea Generating Strategy
(Purpose: to allow the respondent to express their comments/concerns/experiences in regards to flooding and floodplain management).

Flooding has proven to be an ongoing problem and will continue to be. Could you please provide a list of major issues that are important to you with respect to flooding and floodplain management? Please elaborate based on your experience with:

a) Past flood events, such as the 1997 flood, and
b) Current flood management issues, such as the Floodway expansion proposal.

Part 2: Flood Risk Perception
(Purpose: to determine whether or not respondents recognize risk perception as an issue and if so to explore the issues surrounding individual perceptions and also to determine the most effective means of communication). (Risk perception definitions: 1) Perception of a hazard is an individual's understanding of the character and relevance of a hazard for self and/or community (Mileti et al., 1975, p.23); 2) The cognition or belief in the seriousness of the threat of an environmental extreme, as well as the subjective probability of experiencing a damaging environmental extreme (Mileti, 1980, p.186).

Do you feel that you are reasonably aware of the risks associated with flooding? Could you please explain why and how you are aware or unaware of the risks associated with flooding?

After the 1997 flood the government implemented a policy in which homes in the basin were flood proofed to 1997 flood levels plus two feet. Do you think that this government response to flooding and floodplain management is an adequate method of addressing risk? Do you feel more secure now that this policy has been implemented? Overall, do you feel that you are currently safe or unsafe? Why or why not?

During the 1997 flood did you feel that you knew what to do to protect your property and family?

Based on your experiences and awareness of flood risk how would you prepare your family, property and possessions in the event of future floods? Would this be different from the way you prepared in 1997? What has been done since 1997 to keep you informed of risk and mitigating those risks?

Do you feel that institutions or government agencies view (or perceive) the risks associated with flooding similarly or differently from your views? Please explain.

APPENDIX 7: Face-to-Face Interview Instrument for Institutional Representatives (Phase One of the Delphi Process)

CURA Flood Research Partnership – Risk Management Component

Delphi Phase One: Face-to-Face Interviews – ***Institutional Representative Instrument***

Part 1: Idea Generating Strategy
(Purpose: to allow the respondent to express the comments/concerns/experiences of their institution in regards to flooding and floodplain management).

Flooding has proven to be an ongoing problem and will continue to be. Could you please provide a list of major issues that are important to your institution with respect to flooding and floodplain management? Please elaborate based on your experience with:

c) Past flood events, such as the 1997 flood, and
d) Current flood management issues, such as the Floodway expansion proposal.

Part 2: Flood Risk Perception
(Purpose: to determine whether or not institutions recognize risk perception as an issue and if so to explore the issues surrounding institutional perceptions and also to determine the most effective means of communication). (Risk perception definitions: 1) Perception of a hazard is an individual's understanding of the character and relevance of a hazard for self and/or community (Mileti et al., 1975, p.23); 2) The cognition or belief in the seriousness of the threat of an environmental extreme, as well as the subjective probability of experiencing a damaging environmental extreme (Mileti, 1980, p.186).

Do you feel that your institution is reasonably aware of the risks associated with flooding? Could you please explain why and how the institution is aware or unaware of flood risk?

After the 1997 flood the government implemented a policy in which homes in the basin were flood proofed to 1997 flood levels plus two feet. Do you think that this government response to flooding and floodplain management adequately addresses the level of risk facing the basin? (I.e. do you feel that the basin is adequately prepared now that this policy has been implemented)? Overall, do you feel that residents of the basin are currently safe or unsafe? Why or why not?

Based on your institutions' experiences and awareness of flood risk how is it preparing for future flood events? Is this different from the way that it prepared for the 1997 flood or are the same procedures being followed? What has your institution done since 1997 to keep residents of the basin informed of risk and mitigating those risks?

Do you feel that your institution views (or perceives) the risks associated with flooding similarly or differently from the way that residents' of the basin view them? Please explain.

Do you feel that the government and relief agencies provide clear guidance that assists residents in making the best choices for themselves and their property now and in the future?

APPENDIX 8: Cover Letter for Flood Area Residents (Phase Two of the Delphi Process)

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

November 27, 2003

Dear Flood Research Partnership Survey Participant,

On behalf of the Natural Resources Institute, Faculty of Environment, we thank you very much for agreeing to be a participant in our survey – The Community-University Research Alliance (CURA) Flood Research Partnership (FRP): Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin. We understand that your time is valuable and often constrained. Your participation and contribution to this research is vital to the understanding of the complexity of flood risk assessment and management as well as the future of our Province.

As a follow-up of our face-to-face interviews with you in the summer, we are including the first of the two questionnaires that we had discussed. **The questions included in the enclosed questionnaire reflect group or collective concerns or issues and do not reflect individual views and opinions.**

The enclosed questionnaire is the second part of three parts. You have already participated in part 1 and you will receive $50.00 after completing the part 3 questionnaire, which will be mailed to you February 2004.

Your responses will be grouped together with those of other participants. All of the information that you provide will be kept strictly confidential and no reference will be made to you individually.

If you have any problems understanding the questions or if you have any other concerns regarding the survey or the questions, please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and/or please leave a message.

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above named persons or the Human Ethics Secretariat at 474-7122. A copy of the consent form was given to you earlier.

Once again, we highly value and appreciate your participation in this survey and cooperation with our academic endeavour. Thank you for your help and we look forward to working with you further.

Sincerely,

Dr. C. Emdad Haque
Director, Natural Resources Institute and Researcher, CURA – FRP Project

APPENDIX 9: Cover Letter for Institutional Representatives (Phase Two of the Delphi Process)

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

November 27, 2003

Dear Flood Research Partnership Survey Participant,

On behalf of the Natural Resources Institute, Faculty of Environment, we thank you very much for agreeing to be a participant in our survey – Community-University Research Alliance (CURA) Flood Research Partnership (FRP): Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin. We understand that your time is valuable and often constrained. Your participation and contribution to this research is vital to the understanding of the complexity of flood risk assessment and management as well as the future of our Province.

As a follow-up of our face-to-face interviews with you in the summer, we are including the first of the two questionnaires that we had discussed. **The questions included in the enclosed questionnaire reflect group or collective concerns or issues, and do not reflect individual views and opinions.**

The enclosed questionnaire is the second phase of three phases. You have already participated in phase 1 and you will receive the phase 3 questionnaire by mail in February 2004.

Your responses will be grouped together with those of other participants. All of the information that you provide will be kept in strictly confidential and no reference will be made to you individually.

If you have any problems understanding the questions or if you have any other concerns regarding the survey or the questions, please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and/or please leave a message.

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above named persons or the Human Ethics Secretariat at 474-7122. A copy of the consent form was given to you earlier.

Once again, we highly value and appreciate your participation in this survey and cooperation with our academic endeavour. Thank you for your help and we look forward to working with you further.

Sincerely,

Dr. C. Emdad Haque
Director, Natural Resources Institute and Researcher, CURA – FRP Project

APPENDIX 10: Delphi Survey #1 for Flood Area Residents (Phase Two of the Delphi Process)

Note

The following survey is an abridged version that only contains the 9 statements that were pertinent to the risk perception component of the risk management module. The complete survey that was utilized for the broader risk management module contained an additional 16 statements (pertinent to the other research components) that have not been included.

CURA – Flood Research Partnership

Flood Risk Perception: Narrowing the Communication Gap Between the Stakeholders

Phase II: Delphi Survey for Flood Area Residents

Interview Identification Number _____

This questionnaire is to help in the understanding of flood risk perception and risk communication among residents of the Red River Basin. Please note that these questions were generated from the 74 face-to-face interviews that were conducted in the summer.

* This questionnaire is part 2 of 3. You have already completed part 1 (the interview) and you will receive $50.00 after completing part 3 (forthcoming in February 2004).

* No one else will ever know how you answer the questions.

* Please answer all of the questions. If you do not wish to answer a question, simply indicate no comment and move on to the next.

* When you finish the questionnaire, please put it in the envelope provided. Postage is pre-paid and the envelope is return marked.

* Please return by mail no later than December 15, 2003. This timeline will help us to complete this research in time (by spring 2004).

* Your cooperation is greatly appreciated.

* If you have any questions please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and leave a message.

Thank you for your time.

Flood and Floodplain Management

5. Experts in floodplain management (e.g. people with specialized knowledge) see the problem of flooding from very narrow perspectives because many of them do not live in the flooded area.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank and move to question 6.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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6. My experience with governmental agencies, during and after the 1997 flood, has led me to believe that they are not trustworthy or credible, and as such I have strong negative feelings towards them. These negative feelings will affect my future decisions in dealing with these agencies.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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7. A flood equal to or greater in magnitude than 1997 will not occur in my lifetime.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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8. Extreme events and their impacts are so traumatic that they create permanent memories of fear and anxiety that are recalled in subsequent events. As a result, watching the river rise creates fear, anxiety, and stress.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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Emergency Management

17. Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages, while some of those who defied the evacuation order were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank and move to question 18.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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18. Seeing the flood situation in Grand Forks on TV in 1997 demonstrated the seriousness of the flood situation and influenced me to undertake preventive actions (e.g. move belongings out of the basement, start to sandbag, etc.).

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank and move to question 19.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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Forecasting, Long-term Prediction, and Uncertainty

21. **a) Flood frequency** (i.e. flood recurrence within a given time) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).

(Please mark only one option with an 'X' or please leave it blank and move to question 23.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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The survey is now finished.
Thank you for taking the time to complete the survey.

APPENDIX 11: Delphi Survey #1 for Institutional Representatives (Phase Two of the Delphi Process)

Note

The following survey is an abridged version that only contains the 7 statements that were pertinent to the risk perception component of the risk management module. The complete survey that was utilized for the broader risk management module contained an additional 17 statements (pertinent to the other research components) that have not been included.

CURA – Flood Research Partnership

Flood Risk Perception: Narrowing the Communication Gap between the Stakeholders

Phase II: Delphi Survey for Institutional Representatives

Interview Identification Number _____

This questionnaire is to help in the understanding of flood risk, perception, and risk communication among stakeholders of the Red River Basin. Please note that these questions were generated from the 74 face-to-face interviews that were conducted in the summer.

* No one else will ever know how you answer the questions.

* Please answer all of the questions. If you do not wish to answer a question, simply indicate no comment and move on to the next.

* When you finish the questionnaire, please put it in the envelope provided. Postage is pre-paid and the self-addressed envelope is enclosed for you to return.

* This questionnaire is phase 2 of a total of 3 phases. You have already completed phase 1 (the interview) and phase 3 is forthcoming in the new year (February 2004).

* Please return by mail no later than December 15, 2003. This timeline will help us to complete this research in time (by spring 2004).

* Your cooperation is greatly appreciated.

* If you have any questions please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and leave a message.

Thank you for your time.

Flood and Floodplain Management

5. Disaster issues do not maintain a high priority in public perceptions and on political agendas because of their infrequent occurrence, resulting in reduced resource allocation over time.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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6. Structural interventions generally create a perception that places are risk-free and may provide a false sense of security that leads to increased vulnerability.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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8. Differences in flood-risk perceptions that exist between all stakeholders (e.g. urban vs. rural residents, local vs. regional, professional vs. public) create gaps that complicate emergency and floodplain management. Floodplain and emergency management strategies should take into account these differing perceptions.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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Emergency Management

16. To improve risk awareness, as well as emergency preparedness and response, more emphasis should be given to the visual presentation of extreme natural events (e.g. seeing Grand Forks on TV in 1997 verified the seriousness of the situation and prompted many to undertake preventive actions).

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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17. During an event, local communities receive information that is too technical and complex in nature. This requires attention so that local communities receive relevant and useable information regarding all hazards and emergencies.

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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Compensation, Recovery, and Rehabilitation

21. Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages, while some of those who defied the evacuation order were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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Flood Forecasting, Long-Term Prediction, and Uncertainty

24. **a) Flood frequency** (i.e. magnitude, probability) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please leave it blank and move to question 24.)

Strongly Agree_____ Agree_____ Disagree_____ Strongly Disagree_____

Please briefly explain the reasons for your agreement or disagreement with the above statement? If you would you like to add an alternative statement, please state below.

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The survey is now finished.
Thank you for taking the time to complete the survey.

APPENDIX 12: Cover Letter for Flood Area Residents (Phase Three of the Delphi Process)

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

March 5, 2004

Dear Flood Research Partnership Survey Participant,

On behalf of the Natural Resources Institute, Faculty of Environment, we thank you very much for agreeing to be a participant in our survey – Community-University Research Alliance (CURA) Flood Research Partnership (FRP): Promoting Stakeholders' Participation in Sustainable Floodplain Management in the Red River Basin. We understand that your time is valuable and often constrained. Your participation and contribution to this research is vital to the understanding of the complexity of flood risk assessment and management as well as the future of our Province.

As a follow-up to our face-to-face interviews with you in the summer and the mail-out survey from December 2003, we are including the *final survey* requiring your input. The enclosed survey is part 3 of 3 parts. You have already completed part 1 (the interview) and part 2 (the last mail-out survey) ***and you will receive $50.00 after completing and returning this part 3 survey.***

The summary tables included in the enclosed survey reflect summarized group responses. Your responses to this survey will be grouped together with those of other participants. All of the information that you provide will be kept strictly confidential and no reference will be made to you individually.

If you have any problems understanding the questions or if you have any other concerns regarding the survey, please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and/or please leave a message.

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above named persons or the Human Ethics Secretariat at 474-7122. A copy of the consent form was given to you earlier.

Once again, we highly value and appreciate your participation in this survey and your generous cooperation with our academic endeavour. Thank you for your invaluable input and comments.

Sincerely,

Dr. C. Emdad Haque
Director, Natural Resources Institute and Researcher, CURA – FRP Project

APPENDIX 13: Cover Letter for Institutional Representatives (Phase Three of the Delphi Process)

UNIVERSITY OF MANITOBA | Natural Resources Institute
Faculty of Environment

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2N2
Telephone (204) 474-8373
Fax (204) 261-0038

March 5, 2004

Dear Flood Research Partnership Survey Participant,

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As a follow-up to our face-to-face interviews with you in the summer and the mail-out survey from December 2003, we are including the *final survey* requiring your input. The enclosed survey is part 3 of 3 parts. You have already completed part 1 (the interview) and part 2 (the last mail-out survey) *and this completes your participation in our study.*

The summary tables included in the enclosed survey reflect summarized group responses. Your responses to this survey will be grouped together with those of other participants. All of the information that you provide will be kept strictly confidential and no reference will be made to you individually.

If you have any difficulties with the questions or if you have any other concerns regarding the survey, please contact Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455 and/or please leave a message.

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above named persons or the Human Ethics Secretariat at 474-7122. A copy of the consent form was given to you earlier.

Once again, we highly value and appreciate your participation in this survey and your generous cooperation with our academic endeavour. Thank you for your invaluable input and comments.

Sincerely,

Dr. C. Emdad Haque
Director, Natural Resources Institute and Researcher, CURA – FRP Project

APPENDIX 14: Delphi Survey #2 for Flood Area Residents (Phase Three of the Delphi Process)

Note

The following survey is an abridged version that only contains the 5 statements that were pertinent to the risk perception component of the risk management module. The complete survey that was utilized for the broader risk management module contained an additional 7 statements (pertinent to the other research components) that have not been included.

CURA – Flood Research Partnership

Flood Risk Perception: Narrowing the Communication Gap between the Stakeholders
Phase III: Delphi Survey for Flood Area Residents

Interview Identification Number _____

This survey is to help understand flood-risk perception and risk communication among stakeholders of the Red River Basin. Please note: the original statements were generated from the 45 face-to-face interviews that were conducted in the summer of 2003. The summary response tables were generated from the information collected in the last mail-out survey (December 2003)(total number of respondents = 38) and provide a summary of all the responses to the particular statement.

There are 12 questions in this survey. At the top of each page is the original statement we presented in the last mail-out survey. Following each statement is a table containing the total percentage of all flood area residents that had agreement or disagreement with the statement and a summary of the responses that all residents provided to the statement. Please review the information in the tables and record any comments that you may have about each summary response in the space provided. After reviewing each summary response table, please reevaluate the original statement and indicate your agreement or disagreement. If you require any additional space to comment on the summary responses please use the back of the page or the space on the last page of the survey.

* This survey is part 3 of 3. This survey will complete your involvement in the study.
* Following the return of a completed survey you will receive $50.00.

* No one else will ever know how you answer the questions.
* Please answer all of the questions. If you do not wish to answer a question, simply indicate no comment and move on to the next.

* When you finish the survey, please put it in the return marked envelope provided. Postage is pre-paid.
* **Please return by mail no later than March 26, 2004.** This will help us to complete this research in time (by summer 2004).

* Your cooperation is greatly appreciated.
* If you have any questions please leave a message for Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455.

Thank you for your time and patience.

Question 2

A flood equal to or greater in magnitude than 1997 will not occur in my lifetime.

The table below provides a summary of all flood area residents' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	5%	I do not think that this will happen in my lifetime.	
Agree	8%	There is a slight possibility of such a flood in my lifetime, but the chances are higher that there won't be such a flood.	
Disagree	34%	A 1997 level flood can occur in any year depending on the right conditions. No one can predict the effects of weather, climate change, or land management on flooding.	
Strongly Disagree	32%	Climate change, increasing flood frequencies, current farming practices that cause faster run-off, and proof that a much larger flood occurred in the 1800's, suggests that floods of equal or greater magnitude than the 1997 flood will occur in my lifetime.	
No Response	21%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

A flood equal to or greater in magnitude than 1997 will not occur in my lifetime.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 3

Floodproofing up to 1997+2 feet of freeboard is not adequate to provide a sense of security and therefore additional safety measures (e.g. 1997 + more than 2 feet) are required.

The table below provides a summary of all flood area residents' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	35%	Over time, record water levels are always broken. As well, earthen structures (e.g. dikes, dams, roads) will settle with time (below 1997+2). Although floods higher than 1997+2 come less frequently, we need to protect ourselves against them due the catastrophic costs associated with flooding.	
Agree	26%	If an option exists to protect to a higher level it should be done. It may cost more in the short-term, but it is worth it in the long-term. (E.g. after 1979 we built to 1979+3 and stayed dry in 1997, so after 1997 we built to 1997+4).	
Disagree	21%	Based on our past experiences with flooding, the 1997+2 level for floodproofing is adequate as long as the design and construction specifications are properly met, and the cost effectiveness of investment in floodproofing is considered.	
Strongly Disagree	5%	1997+2 is adequate provided that people do not build in areas that flood on a yearly basis.	
No Response	13%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Floodproofing up to 1997+2 feet of freeboard is not adequate to provide a sense of security and therefore additional safety measures (e.g. 1997 + more than 2 feet) are required.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 7

Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages, while some of those who defied the evacuation order were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.

The table below provides a summary of all flood area residents' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	34%	In order to save homes and repair costs, people who are experienced and prepared (i.e. have safety plans, equipment, supplies, flood information, etc.) should be left to use their own judgment. Many residents will not leave next time.	
Agree	34%	Residents cannot rely on the government to protect individual homes after they have been evacuated. Since, residents have so much invested in their property they should be allowed to choose what is best.	
Disagree	11%	The government needs to be in charge in order to save lives and accepts the financial responsibility when they issue an evacuation order. Evacuation is done to protect even those who don't want to be protected.	
Strongly Disagree	3%	Evacuation orders should not be defied because it may put the lives of emergency workers at risk.	
No Response	18%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Some residents who were forced to evacuate from their homes during the 1997 flood incurred significant damages, while some of those who defied the evacuation order were able to save their homes. Therefore, in future events if there is a province-wide evacuation order, it may be defied.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 8

Seeing the flood situation in Grand Forks on TV in 1997 demonstrated the seriousness of the flood situation and influenced me to undertake preventive actions (e.g. move belongings out of the basement, start to sandbag, etc.).

The table below provides a summary of all flood area residents' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	26%	The TV coverage was very convincing, we saw the situation was serious and it gave us time to save some of our belongings and to build a dike. We knew all that water from Grand Forks would have to come our way at some point.	
Agree	34%	Watching the TV coverage influenced my preparation (i.e. moved personal belongings) and encouraged me to seek further information and help.	
Disagree	24%	While Grand Forks was a sad event, it did not influence me. We relied on local forecasts and information to learn about the seriousness of the situation and to take preventive actions.	
Strongly Disagree	13%	We had already built most of our dike by then and had already moved our belongings out.	
No Response	3%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Seeing the flood situation in Grand Forks on TV in 1997 demonstrated the seriousness of the flood situation and influenced me to undertake preventive actions (e.g. move belongings out of the basement, start to sandbag, etc.).

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 11

Flood frequency *(i.e. flood recurrence within a given time) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

The table below provides a summary of all flood area residents' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	29%	Flood events are random and complex phenomena (i.e. 'wet cycles' may bring flood events closer together). As such, communication of flood frequency is poorly understood.	
Agree	42%	Most people believe that because we had a major flood in 1997 it is unlikely that we'll have another major flood in the immediate future. Perhaps what is most misunderstood is that the occurrence of the 1997 flood does not alter the risk of another occurrence of a similar or bigger flood event.	
Disagree	13%	Most people understand what flood frequency means and realize they could get very wet next spring. I think people generally understand the concept of probability.	
Strongly Disagree	3%	No Comments.	
No Response	13%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Flood frequency *(i.e. flood recurrence within a given time) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

APPENDIX 15: Delphi Survey #2 for Institutional Representatives (Phase Three of the Delphi Process)

Note

The following survey is an abridged version that only contains the 4 statements that were pertinent to the risk perception component of the risk management module. The complete survey that was utilized for the broader risk management module contained an additional 8 statements (pertinent to the other research components) that have not been included.

CURA – Flood Research Partnership

Flood Risk Perception: Narrowing the Communication Gap between the Stakeholders
Phase III: Delphi Survey for Institutional Representatives

Interview Identification Number _____

This questionnaire is to help understand flood-risk perception and risk communication among stakeholders of the Red River Basin. Please note: the original statements were generated from the 19 face-to-face interviews that were conducted in the summer of 2003. The summary response tables were generated from the information collected in the last mail-out survey (December 2003)(total number of respondents = 16) and provide a summary of all the responses to the particular statements.

There are 12 questions in this survey. At the top of each page is the original statement we presented in the last mail-out survey. Following each statement is a table containing the total percentage of all institutional representatives that had agreement or disagreement with the statement and a summary of all the responses to the statement. Please review the information in the tables and record any comments that you may have about each summary response in the space provided. After reviewing each summary response table, please reevaluate the original statement and indicate your agreement or disagreement. If you require any additional space to comment on the summary responses please use the back of the page or the space on the last page of the survey.

* No one else will ever know how you answer the questions.
* Please answer all of the questions. If you do not wish to answer a question, simply indicate no comment and move on to the next.

* When you finish the survey, please put it in the return marked envelope that is provided. Postage is pre-paid.
* **Please return by mail no later than March 26, 2004.** This will help us to complete this research in time (by summer 2004).

* This survey is part 3 of a total of 3 parts, and returning this survey will complete your involvement in our study.
* Your cooperation is greatly appreciated.

* If you have any questions please leave a message for Mike Olczyk or Rob Stewart at the Natural Resources Institute at 474-9455.

Thank you for your time and patience

Question 3

Differences in flood-risk perceptions that exist between all stakeholders (e.g. urban vs. rural residents, local vs. regional, professional vs. public) create gaps that complicate emergency and floodplain management. Floodplain and emergency management strategies should take into account these differing perceptions.

The table below provides a summary of all institutional representatives' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	27%	All stakeholders involved in floodplain management should have input into decision-making.	
Agree	40%	These gaps certainly do exist and lead to confusion in floodplain management. Although, effective strategies that work and take steps in this direction have not yet been developed. These gaps are not easily overcome but better information and communication will help.	
Disagree	20%	Important infrastructure needs to take priority. These differing perceptions are less significant in emergency and floodplain management.	
Strongly Disagree	0%	No comments.	
No Response	13%	No comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Differences in flood-risk perceptions that exist between all stakeholders (e.g. urban vs. rural residents, local vs. regional, professional vs. public) create gaps that complicate emergency and floodplain management. Floodplain and emergency management strategies should take into account these differing perceptions.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 8

To improve risk awareness, as well as emergency preparedness and response, more emphasis should be given to the visual presentation of extreme natural events (e.g. seeing Grand Forks on TV in 1997 verified the seriousness of the situation and prompted many to undertake preventive actions).

The table below provides a summary of all institutional representatives' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	27%	Pictures are worth a thousand words; we must use visual media to convince the public that 'things' are serious.	
Agree	40%	Such images bring home the reality of emergency situations and the need to act. Visual images provide early warning in order to prepare.	
Disagree	27%	This is somewhat dangerous and may cause unnecessary panic. Fear does not help encourage preparedness.	
Strongly Disagree	6%	Mitigation and flood preparedness are all that is needed.	
No Response	0%	No comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

To improve risk awareness, as well as emergency preparedness and response, more emphasis should be given to the visual presentation of extreme natural events (e.g. seeing Grand Forks on TV in 1997 verified the seriousness of the situation and prompted many to undertake preventive actions).

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 9

During an event, local communities receive information that is too technical and complex in nature. This requires attention so that local communities receive relevant and useable information regarding all hazards and emergencies.

The table below provides a summary of all institutional representatives' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	13%	Don't assign technocrats or specialists for public communication; technical information needs to be clearly translated for the public to understand.	
Agree	56%	Emergency management agencies must find ways to communicate in plain language when providing important information. At the same time, local communities must improve their knowledge of technical issues.	
Disagree	25%	Local community leaders should be capable of understanding technical aspects of forecasts and predictions, such as water levels and land elevation. Presently, the Province and the City of Winnipeg are more sensitive to these problems than in the past.	
Strongly Disagree	0%	No comments.	
No Response	6%	No comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

During an event, local communities receive information that is too technical and complex in nature. This requires attention so that local communities receive relevant and useable information regarding all hazards and emergencies.

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

Question 12

Flood frequency *(i.e. magnitude, probability) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

The table below provides a summary of all institutional representatives' responses to the above statement that was asked in the previous survey. Please review and comment on any or all of the following summary responses in the space provided (blank column).

	%	Summary Responses	**Please review and comment on the summary responses in the spaces below**
Strongly Agree	34%	Statistics dull the senses. Experts must translate and show graphics, etc. to identify what they mean in clear language. Public understanding of these meanings is essential.	
Agree	53%	Flood frequency needs to be clarified and explained to residents simply and in real terms, because percentages are always confusing (e.g. use the 1997 flood as a benchmark when explaining the level of flood risk).	
Disagree	13%	An understanding of flood frequency and other estimates of risk by some floodplain residents is necessary in flood and emergency management, however, we shouldn't be concerned if everyone does not understand flood frequency.	
Strongly Disagree	0%	No comments.	
No Response	0%	No Comments.	

After reviewing the above summary responses, what is your position regarding the following original statement?

Flood frequency *(i.e. magnitude, probability) is not easily understood by some floodplain residents. (For example, the 1997 flood, which has a return period of 1 in 100 years is often misinterpreted to mean that it will not take place for another 100 years, whereas the reality is that there is a 1% chance that such a flood could take place in any year).*

(Please mark only one option with an 'X'. If you cannot evaluate the statement then please mark no comment).

Strongly Agree _____ Agree _____ Disagree _____ Strongly Disagree _____ No Comment _____

APPENDIX 16: Manitoba Emergency Plan Appendix A: Emergency Action Guidelines 1 – Flood Emergency

Guidelines for Safe Habitation and Emergency Management in the Designated Flood Zone Not Including Valley Town Dikes

Overview

Living on a flood plain poses many concerns for those tasked with the management of emergency preparedness. There must be a balance between the need for safety and the desire to protect and maintain property and agribusiness operations. Since the time of the first dike structure on a floodplain, Manitobans have calculated the risks and made plans to deal with the threat. Properly engineered and maintained dike systems offer safe and reliable protection. Experience has demonstrated the value of emergency management planning in the unlikely event of an extreme flood situation. At all times common sense and adherence to Provincial Statutes, Acts and Regulations must be considered.

Dike Structures

Dike structures in Manitoba fall under two broad categories:
a) Permanently constructed engineered structures.
b) Temporary dikes of earthen or sandbag type construction.

Permanent structures are engineered to protect to a design flood water level with allowance for projected wind and wave action. The structures are designed to take into account subsoil conditions, anticipated hydraulic loading and the properties of the material to be used in constructing the dike.

Temporary dikes are often hastily constructed of various soils and materials, which lack engineering support, and may not have sufficient compaction or sub-base preparation. These dikes may be earthen, sandbag, soil and polyethylene or of a wooden flashboard type. The variability in design and construction of these structures makes them less reliable and therefore reduces the level of protection afforded the property and communities they protect. Sandbag dikes more than five feet high (three feet of water protection) is *not recommended*.

Emergency Management

This table summarizes the action guidelines and trigger points for various dike structures that may be found in a flood plain municipality. These guidelines apply to property protected by private ring dikes or pads and property protected by a linear Provincial dike structure. Ring dike town guidelines are found in the appropriate Operation and Maintenance Manual prepared by Department of Conservation. It must be understood that these guidelines must be applied to the realities of the situation and modified where necessary by the local authority to ensure the safety of life. The decision to evacuate need not wait until water levels reach a particular level. Evacuation can be ordered based on the forecasted level or predicted threat and circumstances.

Dike Type	Dike Height	Distance Of Residence From Dike Or Designated Zone[1]	Water Level	Action
Permanent	Greater than 10 Feet	Less than 1/2 Mile (depending on nature of topography).	4' below dike top or when clear road access is threatened	Evacuate all nonessential personnel
			Design flood stage[3]	Evacuate all personnel unless there is a safe method of evacuation
		Greater than 1/2 mile	4' below dike top	Alert all personnel - 24 hrs notice to move
			Design flood stage[3]	Evacuate all nonessential personnel and non-protected sites[2]
	Less than 10 feet	Less than 1/2 mile	3' below dike top or when clear road access is threatened	Evacuate all nonessential personnel
			Design flood stage[3]	Evacuate all personnel unless there is a safe method of evacuation
		Greater than 1/2 mile	3' below dike top	Alert all personnel - 24 hrs notice to move
			Design flood stage[3]	Evacuate all nonessential personnel and non-protected sites[2]
Non-permanent	Not to exceed 5 feet	Any	At base of dike or when clear road access is threatened	Evacuate all nonessential personnel
			More than 3' of water against dike	Evacuate all personnel unless there is a safe method of evacuation
Pads		Any	If road access is compromised	Evacuate all nonessential personnel
		Any	If water over pad	Evacuate all personnel Note: if dike is built on pad follow guidelines for appropriate dike type and condition above

1 - Designated Zone: A designated zone is an area within a municipality that, because of its topography is at a greater risk of flooding.
2 - Non-protected site: A non-protected site is a structure or location that offers no or

minimal protection against the effects of the expected flood water levels and when no dry road access to the property remains
3 - Design flood stage: The design flood stage is the engineering estimate of the safe levels of water up to which the dike structure will offer protection.

Remaining in a Flood High Risk Area - Essential Personnel

Definition: Essential personnel are those individuals essential to maintain dikes, necessary utilities/ equipment, confined livestock operations etc. and for the protection of property.

When essential personnel are to remain behind after the general evacuation of a location, they must be capable of protecting themselves. Though not all-inclusive the following are offered as the minimum criteria to be met before permission should be granted to individuals to remain behind.

- There is a real need to remain behind (essential personnel),
- There is a minimum of two competent adults,
- All individuals are free of health risks,
- An on-site boat and safety equipment is available that is capable of transporting the party,
- Emergency wireless communications are available on-site, including signal equipment (lights and roofs signals),
- Adequate food, potable water, fuel and equipment are available for staff for the expected duration,
- Any diking is approved by the municipality, and
- The site rescue plan is approved by the municipality.
- For confined livestock operations, adequate feed and water and housing space is available for the duration of the event
- Standby electric power and fuel is available on site to operate the facility for duration of the event.

Note: This guideline does not remove the authority for local authorities to take whatever action is necessary to mitigate loss of life or injury, nor does it exempt local authorities from the responsibility to take action where circumstances dictate to prevent the loss of life or injury.

Source: http://www.gov.mb.ca/itm/emo/eplan/mepa1.html