

## Institutional assistance for flood-disaster recovery and its impact on resilience in the Red River Basin

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**Abstract:** Flood resilience refers to the capacity of a community to ‘bounce back’ quickly during the post flood period without permanent, intolerable damage, or disruption, and without large amounts of outside assistance. The recovery period after a major flood is a time to focus attention on enhancing such resilience. This study assesses the extent to which recovery assistance provided by Canada and the United States to selected localities after the 1997 floods on the Red River of the North did or did not actually contribute to flood resilience. Only the structures that include residences, commercial and business buildings, public facilities, and infrastructure such as roads, bridges, and treatment plants are examined.

In both countries, some forms of assistance did contribute somewhat to providing a higher level of protection for at least some structures; helped increase the local stock of flood-free buildings to some extent; and helped build local self-sufficiency in some ways. For other type of assistance, the impacts varied. In Canada, removal of structures and the promotion of repairs that would reduce future damage did not occur programmatically. In the United States, recovery assistance was used to permanently remove hundreds of structures from floodplains; to encourage the purchase of flood insurance; and to fund some mitigation measures. In neither country did recovery assistance strongly foster individual responsibility or self-sufficiency, or taking steps to prepare for a future flood that may exceed the design levels of the structural flood control works.

The research concluded that there was more opportunity for using recovery assistance to foster flood resiliency in the Red River Basin than was used after the 1997 floods. A key area for future research is the impact of recovery assistance on the other aspects of resilience, since the narrow

focus of this study is but one influence on the long-term flood resilience of communities.

Key words: flood resilience, recovery, mitigation, institutional assistance, Red River

## Introduction

From the initial advice that the spring flood of 1997 in the Red River Valley was likely to be an unusual event until the period when the flood waters crested, the focus of attention of various government and non-government organizations was on fighting the flood waters and taking steps to protect people and property. As the magnitude of the disaster became manifest, first in North Dakota and Minnesota, USA, and then in Manitoba, Canada, attention shifted to the process of recovery. The desire of people whose property has been flooded and whose lives have been at risk is to see things returned to normal in the first place as rapidly as possible. This implies putting their place of residence, their family, their social involvement, and their economic livelihood back as they were before. More serious reflection may reveal that this is rarely if ever possible, and that recovery from disaster inevitably involves adaptation to new circumstances, both in the community and in individuals' personal lives.

The institutional and organizational actions taken in the short term to respond to suffering and hardship, and measures taken to help restore *status quo* can have long-term effects with different outcomes. Such measures can make both individual households and entire community more resilient and better able to cope with and recover from future events of a similar magnitude. They can also help to recreate situations of similar or greater vulnerability by supporting and facilitating inappropriate and often short-sighted actions. The rise in losses due to disasters in both Canada and the United States indicates that the recurrence of extreme events is often associated with a net increase in property and personal loss in spite of the well-intentioned efforts at recovery and reconstruction that have made before. Formulating and implementing a recovery assistance program by the government and non-government agencies that will reduce longer-term vulnerability while

simultaneously providing quick relief from the disaster impacts appears to be extremely difficult.

This research addressed both disaster mitigation and long run social resilience to study the above stated issues. Mitigation refers to those applied measures that can be taken to reduce vulnerability to future events, for example, removing building from flood prone areas. Beyond those well-defined mitigation measures lies a wider array of possible actions that can help to strengthen the resilience of individuals, communities, states/provinces, and regions. Resilience is a much broader concept than mitigation and numerous factors enter into successful resilience. The scope and focus of this study was kept limited to a few selected components of resilience and mitigation, namely that of building structures, including residences, public facilities, commercial buildings and major infrastructure such as roads, bridges, and treatment plants. Specifically, this study assesses the extent to which recovery assistance provided by Canada and the United States to selected localities after the 1997 floods on the Red River did or did not actually contribute to one category of flood resilience – that of structures. It addresses the following questions: could the citizens of the Basin and their institutions and organizations cope better with another flood of similar or even greater magnitude? Would the losses to structures be greater or less? Has the ability of the region to bounce back – its resilience- been increased or decreased?

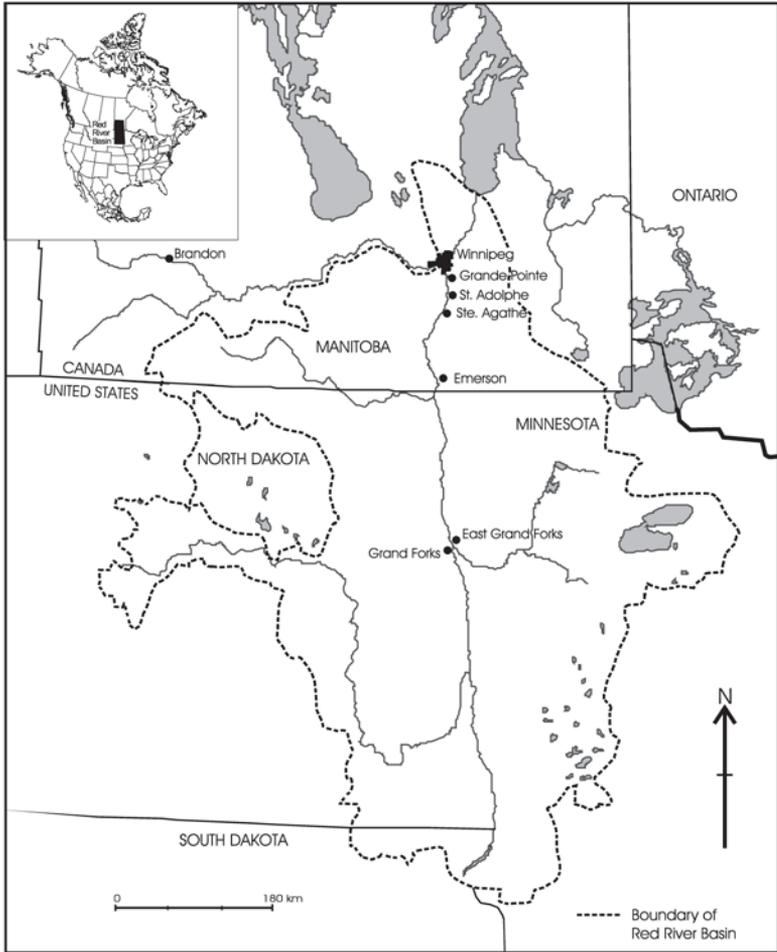
## Conceptual Considerations

Determining how recovery assistance can help build flood-resilient communities in the Red River Basin requires exploration of both the concepts and measures of resilience, and of the linkages between recovery assistance and resilience. Conceptually, resilience is the ability to change and rehabilitate a system to a sustainable and persistent order (Blaikie *et al.* 1994). In the context of natural disasters, it is the quality of being able to ‘bounce back’ quickly from an extreme natural event – a flood – without permanent, intolerable damage to, or disruption to, or disruption in, social, structural, economic, or biophysical systems, and without large amounts of outside assistance (Mileti 1999; Smith 1996).

Many possible activities, techniques, and measures can be employed to promote flood resilience. Warnings, flood control measures, maintenance of flood-prone areas as open spaces, property insurance against flood damage, installation of flood-resistant construction, and management of stormwater all are included. Virtually any mitigation measure that minimizes future flood losses or impacts can contribute to flood resilience. When these activities, methods, and measures are comprehensively combined for a specified area, and when they do not detract from then other precepts of sustainable development, then the area can be termed ‘flood resilient’.

The Long-term Recovery Task Force, established by the American President during the wake of the Red River flood of 1997, has listed components for a sustainable Red River Basin that are similar to the sustainability precepts defined by the well-known 1987 World Commission on Environment and Development. The components include: a healthy environment, a vital workforce, a vital economic base, sound infrastructure, and adequate housing (FEMA 1977a; 1977b). Transforming that ‘sustainable Red River Basin’ into a flood-resilient Basin involves ensuring that every possible element of these components can withstand, and quickly recover from, a future flood; some of the elements of a disaster-resilient, sustainable river basin are depicted in Figure 1. A flood-resilient river basin, for example, could be one in which there are riparian areas in natural or restored condition. Infrastructure and critical facilities are resilient to flood damage by virtue of location, floodproofing, or other techniques. A flood-resilient economy requires that local business premises are not at direct risk from waters and that the economy is sufficiently diversified so that not all the local business is destroyed. Flood-resilient residents, essential to providing a vital workforce, are those that understand and have adopted acceptable levels of risk, are adequately insured, and know what to do when flood threatens.

Identification of the characteristic elements of flood resilience is required to assess and enhance basin and community resilience. One effective way is to parallel these categories used to inventory flood impacts. For instance, impacts are often expressed as number of people evacuated; damaged residential structures; number of



*Figure 1: Drainage basin of the Red River.*

deaths and injuries; weeks of business interruption or dollar cost of local business; days of disruption to transportation; quantity of soil eroded and acreage of lost habitat. With this approach, achieving a resilience measurement depends on the adoption of one or more of these loss categories, in a temporal framework, as a category of resilience.

## Study Area and Methodology

Considering the available time and resources, the study area of this research in the United States was limited to two hardest-hit communities: Grand Forks, North Dakota, and East Grand Forks, Minnesota. In Canada, the study focused on selected areas of Manitoba affected by the flood: the Rural Municipality (RM) of Ritchot (including the communities of St. Agathe and Grand Pointe), and the St. Norbert area within Winnipeg. The RM of Ritchot is located immediately south of Winnipeg, consists of an area of 144 square miles, and has a population size of 5,300. St. Norbert – a suburb of Winnipeg – is located immediately north of Ritchot; more than 9,000 people live here. The La Salle River flows through the southern part of St. Norbert and enters the Red River north of the Floodway that protects the City of Winnipeg. While there are a few homes south of the Floodway, most of St. Norbert is protected by it.

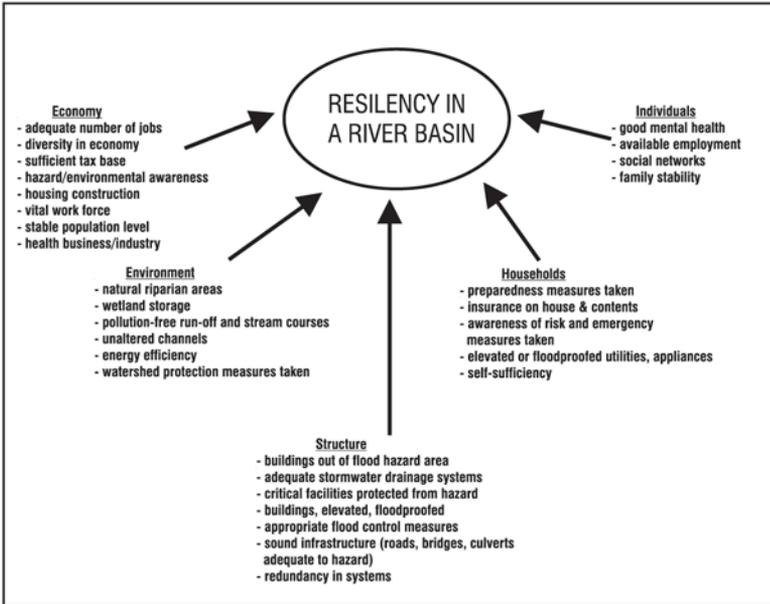
This study is intended to determine the extent to which various streams of assistance for structures did or did not foster various means of either reducing future flood losses to one dimension of human occupancy of the floodplain or enhancing other aspects of resilience in the Red River Basin. In order to attain its goals, it attempted, first, to characterize the recovery assistance programs provided to all pertinent groups including individuals, businesses, and public entities such as cities, RMs, school districts, and counties. This characterization consists of a summary of the types and extent of both financial and technical assistance provided to assist in recovery from the flood, and was based on an extensive literature review of secondary-source materials. The information was supplemented by the semi-structured interviews of the pertinent federal, state/provincial agencies; local governments; and private sector groups.

Review of the various types of assistance and determination of how effective each was in promoting future flood-resilient communities in the Basin were then attempted. Only the flood resilience of building structures was examined. The ultimate question for this category of flood resilience was to determine if the number of at-risk structures was minimized, and to what extent,

as a result of the recovery assistance provided. In order to investigate whether recovery assistance influenced flood resilience by its effects on the structures affected, or threatened, by the 1997 flood, a total of nine criteria were used. If a type of recovery assistance met any one of these criteria, it was considered to have contributed to resilience in the Basin. The nine criteria were structured in the following manner: did the recovery assistance provided for the structure(s): (i) result in the permanent removal of residential or commercial structures from the floodplain; (ii) result in a level of flood protection greater than that existing before the 1997 flood or reduce exposure to future damage; (iii) supplement housing or other building stock outside of the floodplain; (iv) promote insuring structures against flood damage; (v) facilitate recovery from future events; (vi) foster self-sufficiency and responsibility; (vii) operate without significant gaps in delivery or coordination that would have detracted from victim recovery; (viii) provide for mitigation approaches, either with specific policies, funding, or other means; (ix) promote community livelihood, quality of life, or environmental quality?

### **Recovery Assistance in Manitoba, Canada**

During the 1997 flood, residents of both the RM of Ritchot and St. Norbert were evacuated – the former because of the high water on the Red River; the latter because of the threat that the floodwaters might by-pass the Floodway and enter the City of Winnipeg through the La Salle river system. As a result, both of these entities were faced with problems associated with evacuation, re-entry, and recovery. At the peak of the flood in early May, 132 square miles (92 percent of its total area) of the RM of Ritchot were flooded, and by then, more than 4,000 people from over 800 homes were evacuated. The RM processed, after the flood, over 1,100 claims related flood damage; temporary housing (apartments or trailers that were placed on their properties) was needed for about 480 families (Figure 2). After the recession of the floodwater, about 115 homes were condemned. Most were rebuilt to the new standards declared by the Province of Manitoba.



**Figure 2:** Elements and components of resilience in a river basin (adopted after Myers, M.F. et al., 1999).

Contrary to these perspectives, there was little structural damage in St. Norbert. Thirty-two homes, many of these either south of the Floodway or immediately north of it, were damaged. Some homes had water damage; others had structural problems from flood-induced ground motion. The variation between the extent of damage in St. Norbert and the adjacent RMs is attributable to protection provided by the operation of the Floodway, which, at peak flows during the flood, diverted a flow that exceeded its design capacity.

On April 23, the Provincial government called for a mandatory evacuation, and the RM of Ritchot proceeded to advise its residents of the evacuation. Subsequent to the evacuation, Ste. Agathe and Grande Pointe flooded from unexpected overland flooding. One of the responsibilities of MEMO, as specified in the 1996 Emergency Measures Act, is to deliver the disaster financial assistance (DFA) program. The magnitude of the program was established in federal-provincial agreements that were reached during the early stages of the flood. Table 1 provides a summary of

**Table 1: Private claims awards per rural municipality south of Winnipeg (as of February 5, 1999).**

Rural Municipality	Amount of Award		% of Total Award \$	Number of Claims	% Total Claims	% Claims Closed
	Total \$	Average \$				
De Salaberry	2,067,026	9,938	2.6	208	3.8	84
Franklin	1,655,213	12,171	2.1	136	2.5	75
Hanover	240,131	11,435	0.3	21	0.4	71
MacDonald	3,305,977	9,209	4.1	359	6.6	78
Montcalm	6,014,929	19,217	7.5	313	5.8	60
Morris	11,294,127	18,014	14.1	627	11.6	65
Morris (Town)	90,555	1,927	0.1	47	0.9	98
Rhineland	1,394,534	8,012	1.7	190	3.5	64
Ritchot	36,627,388	32,791	45.7	1117	20.6	59
Roseau River	1,281,997	8,012	1.6	160	2.9	99
Tache	1,406,201	7,211	1.8	195	3.6	84
Winnipeg	8,780,463	8,191	10.9	1072	19.7	87
Manitoba Total	80,201,922	14,776		5428		75

Source: MEMO, 2000.

the claims made to the MEMO by individuals in the rural municipalities south of Winnipeg as of February 5, 1999. It appears that both the RM of Ritchot and the City of Winnipeg accounted for about 20 percent of the claims. However, Ritchot had the largest average per claim award and over 45 percent of the total dollars awarded. The data confirms that the impact of the flood was greatest in Ritchot. One important feature was that almost two years after the flood, a large number of the residents of Ritchot have not completed their recovery based on the criteria used by the federal and provincial assistance programs.

The concerns with dissatisfaction with the initial delivery system for post-flood assistance, that required residents to deal with compensation claims in Winnipeg, were reported to the Manitoba Emergency Management Organization (MEMO) by the municipal authorities (Rahman and Tait 1997). Subsequently, MEMO opened three regional offices in the valley (at Letellier, Rosenort and St. Adolphe) in August 1997. Residents were provided “one stop shopping” for recovery assistance in this way (Figure 2). This initiative not only enhanced inter-agency communication, but also improved communication between the municipal office and the provincial agencies. Figure 2 in no way represents the situation faced by flood victims in St. Norbert. Once re-entry occurred, the victims received little guidance from the City authority; the latter focussed on its infrastructure issues such as stabilizing the river

bank, and planning and establishing permanent dikes. What emerged during the initial part of the flood recovery process was a case management approach to dealing with flood victims. The strengths of this approach have been recognized by MEMO and it has modified its emergency plan (MEMO 1999). When executed properly, the approach minimizes the irritation of claimants, provides them a continuity that desperately needs to be reestablished in their lives, and provides an opportunity to identify early signs of psychological difficulties. The processes leading to its establishment during the flood of 1997 resulted, in the unintentional opposite effects. Although the post flood institutional assistance consisted of financial, social and structural programs, due to the limited scope of this paper only structural assistance is examined in the remainder of this section.

The recovery phase happened in two stages, with the stages corresponding to the two different financial assistance programs of the provincial and federal governments. In the first stage, rebuilding to pre-flood standards occurred; in the second stage, floodproofing, as defined by the provincial government, occurred. Often the two occurred together, but the homeowners found themselves doing it in stages because of the uncertainty of the financing.

Once the conditions for re-entry had been met, homeowners and communities faced the dual tasks of cleaning up flood debris and damage, and rebuilding their homes and other structures. The City of Winnipeg, MEMO, and the Mennonite Disaster Services engaged in an active program of public education. On August 5, 1997 the Red Cross announced *Operation Homecoming* to help people begin rebuilding. For those whose homes needed major repairs to become habitable (estimated to be 650 at that time), the Red Cross provided a grant of \$6,000.

In initiating its floodproofing program, the provincial government had setup the following minimum criteria for flood damage reduction construction (Water Resources Branch, 1997) with the intention to rebuild and create new building standards:

- House with a basement*: main floor equal to the 1997 level plus 3 feet; fill elevation equal to the 1997 level plus 2 feet.
- House without a basement*: main floor equal to the 1997 level plus 2 feet; fill elevation at the 1997 level plus 1 foot.

·*House raised on posts or piles:* main floor equal to the 1997 level plus 5 feet; finished grade at the foundation not lower than 3.5 feet below the 1997 level.

·*Ring dikes:* 1997 level plus two feet.

·*Attached garages:* floor elevation equal to the 1997 plus 1 foot; fill at the 1997 level.

·*Detached garages:* floor may be up to 3 feet below the 1997 level, but the structure should be waterproof up to the 1997 level.

To qualify for floodproofing assistance, both homeowners and rural municipalities had to choose procedures that would hold back water to these levels. The provincial and federal governments have proposed the creation of a co-funded buyout program as a measure of last resort.

The federal and provincial governments had committed \$130 million to a Flood Proofing Program for Manitoba under a 50:50 cost sharing agreement. The program had two components: one for individuals, the other for communities. Assistance for individuals, which included homeowners, farms, and small business, is provided up to a maximum of \$60,000, to raise foundations, construct dikes, or relocate to a protected community. Once the project has been approved, the work must be completed within five years. As an incentive, individuals who commit to an approved floodproofing project will have their 20% share of their disaster financial assistance claim waived (Manitoba Natural Resources 1999). As of January 1999, about 800 homes had been protected under the program with another 300 residences expected to be included over the subsequent years. For a homeowner, floodproofing typically meant employing one of the two procedures: either surround buildings with a ring dike built to the required level, or construct a mound to this height and then place the domicile on top of it. A small number of homeowners chose to relocate to protected communities.

The other component of the program is to assist communities in the construction of protective ring dikes. Potentially more than 20 communities may participate, including Ste. Agathe and Grande Pointe. The cost sharing arrangements for construction costs are proportioned 45% for the federal government, 45% for the provincial

government, and 10% for municipal governments. For the communities in the rural municipality, the only option was to construct dikes or to raise the existing dikes (e.g., St. Adolphe). Responsibility of the incurred costs of construction and subsequent costs of dike maintenance are the focus of discussions between the provincial and the municipal governments.

## **Recovery Assistance in Grand Forks and East Grand Forks, USA**

In April 1997, the cities of Grand Forks, North Dakota, and East Grand Forks, Minnesota, USA, experienced one of the most devastating floods in their history on the heels of a long and severe winter that featured eight blizzards and record-breaking snowfall. Between April 4 and mid-April, 1997, floodwaters continuously rose, and dykes began to fail or overtop, resulting in orders to evacuate both cities. By the time the Red River crested at 54.11 feet on April 21, 1997, 90 percent of Grand Forks' 52,000 residents and virtually all of the 9,000 residents of East Grand Forks had evacuated. Seventy-five percent of Grand Forks homes (approximately 7,800) and all but 27 of the 2,300 homes in East Grand Forks were flooded with polluted waters. Both the cities' downtown business districts were heavily impacted by the floods. As an example, all of the 315 firms in downtown Grand Forks, employing nearly 3,800 workers, were flooded. The worst damage was suffered by 11 commercial buildings that were destroyed by fire during the peak of the flooding. The Corps of Engineers estimated the total flood-related damage in the Grand Forks and East Grand Forks area to be between \$ 1 and \$1.5 billion. In all, it was the worst disaster per capita in the United States.

There were a wide variety of types of assistance provided to the Greater Grand Forks area to help in the recovery efforts. Individuals, businesses, municipalities, and groups of all kind received financial assistance in the form of grants; loans with a variety of generous provisions including no interest, low interest, deferred payments, and potential for forgiveness; claims payments both from general landowners' and business insurance and from flood insurance. Some of the recovery funds came with conditions

attached: either they were to be used only for a specific purpose, or applied only to certain categories of structures, or were only available upon agreement by the recipient to take additional actions, such as agreeing not to sell the building for a certain period, or purchasing flood insurance.

Technical assistance likewise came in many forms and from many sources. At a minimum, federal and state agencies who provided funds typically also provided guidance on the administrative aspects of applying for and utilizing those funds, and on using them to meet the goals for which they were intended. Many federal and state agencies assigned numerous personnel the specific tasks of helping the communities and individuals recover and mitigate future losses. These personnel included specialists in engineering, law, housing, code enforcement, building practices, planning, economic development, and environmental issues, to name a few. Both the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (a 75/25 federal/local cost share) and the U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grant program provided large contracts with outside consultants to bring them into the area to make expert advice available. Few if any conditions were attached to the technical assistance that was provided to the area.

A third type of recovery assistance was provided by the many non-profit entities, charitable organizations, church groups, and others. For the buildings examined during this research project, this assistance mostly took the form of cash, volunteer labor, and donated materials for repair and rebuilding.

In general efforts to avoid duplication of recovery assistance were fairly widespread. No doubt some instances of taking advantage of the situation could be uncovered, but the government agencies, private entities, and nonprofit groups had a systematic means of coordinating their programs both to provide people with the widest range of help available and also to prevent misuse of the opportunities. The voluntary agencies also took steps to avoid, for instance, providing free building materials to a homeowner who already received an insurance claim to cover the damage.

## **Recovery Assistance in Contributing to Long-Term Flood Resilience**

The types of recovery assistance provided in both Canada and the United States after the 1997 floods varied widely in their contribution to overall resilience of the Basin. Efforts and effectiveness to promote resilience through such assistance is summarized in Table 2. Both Canada and the United States have programs and policies to assist localities and individuals during the period of recovery after a major flood. In an ideal world, the recovery period should be a time to focus attention on advancing flood resilience. Influx of additional funds into flooded localities, technical assistance, various types of additional expertise, and political attention all combine to make the post-flood period one in which many things temporarily become possible that would otherwise be out of reach. An excellent opportunity to advance flood resilience, instead of returning to status quo, resides in this post-flood recovery period. Governments and other institutions can improve resilience in the Red River Basin by ensuring that recovery policies and programs foster ability to adapt to change and recover in a way that is sustainable.

Based on the nine criteria stated above, a comparative analysis of recovery assistance and resilience, primarily in terms of structures, between Canada and the United States is attempted. While some structures on the floodplain in Manitoba were removed, it is not possible to attribute this to either the intent or the actions of the recovery assistance programs. The purpose of the Disaster Financial Assistance Arrangements is to restore dwellings to pre-flood conditions; this encourages fixing or rebuilding structures, not removing them. Neither the City of Winnipeg nor the Rural Municipality has regulations that determine whether a structure should be removed and under what conditions this should occur. Even when structures are threatened by river bank instability there appears to be no great urgency to remove it.

The voluntary buyout programs in the Greater Grand Forks, USA, area funded with recovery assistance monies included the actual purchase of the buildings and their lots, demolishing or relocating the houses, and incentives to hundred of homeowners to

**Table 2: Efforts to promote resilience: summary and comparisons across the border.**

Does the Recovery Policy, Program, or Assistance:	In Canada	In the United States
Result in permanent removal of structures from floodplain?	X	✓
Provide increased protection of structures from flood? (floodproofing, etc.)	✓	✓
Supplement flood-free building stock?	Q✓	✓
Promote insuring structures?	X	Q✓
Facilitate recovery in the future (a) from an equal-to or less than 1997 event, (b) from a greater than 1997 event?	Q✓ QX	✓/X ?
Foster responsibility/self sufficiency (a) at the community level, (b) at the individual level?	Q✓ X	✓/X ✓/X
Operate without significant gaps in delivery or coordination that direct from victims' recovery?	X	✓
Provide specifically for mitigation?	QX	✓
Promote community livelihood?	Q✓	✓
✓ = X = no ? = not clear from study Q✓ = qualified yes QX = qualified no		

sell their flood-prone houses. Although approximately 1,300 residential structures were purchased through the buyout programs, only about 800 of them, or about 8% of all those damaged in the flood, were permanently removed from the 100-year floodplain and adjacent flood-prone areas. The land vacated by the remaining 500 flood-prone houses may or may not be redeveloped. The recovery assistance, overall, for the buyout program contributed to resilience by removing some structures from the flood-prone areas, and by allowing the cities to maintain that area as open space to that future flood damage will be minimized.

### Conclusions and Policy Recommendations

The types of recovery assistance provided both in the United States and Canada after the 1997 floods on the Red River of the North varied widely in their contribution to overall resilience of

the Basin. They included financial assistance consisting of grants, loans, cost-sharing, and gifts; technical assistance; and contributions of services, materials, and other needed goods. Although it is not possible after a flood of this magnitude to put things back just the way they were before, it is fair to suggest that the recovery effort was effective in restoring the buildings and other structures in the Basin. This study focussed on structures, but the collateral evidence indicates that economic restoration also was facilitated by the recovery activities. Less success was registered at the household and individual level, particularly in Canada, where problems were identified during the recovery period.

In Canada, recovery assistance focused on restoring structures. The opportunity to take major mitigative action was missed. Removal of structures, buyouts, and the promotion of repairs that would reduce future damage did not occur programmatically. Only the narrowly defined floodproofing program was activated. The term “floodproofing” could be misleading, particularly when relatively low levels of protection are being advocated. To the uninformed, it means that if the standard is met, they should be safe, that is, the risk is zero. Consequently, when the inevitable large flood occurs, they will feel betrayed and be angry, the same emotion expressed during the flood of 1997. The false sense of safety generated by this flood protection program works against the long-term resiliency of the residents.

The 1997 Flood Proofing Program in Manitoba was designed to provide increased levels of flood protection. When the current projects are completed, all the communities in the province will have better flood protection than they had before the 1997 flood, and with due vigilance and diligence during a flood episode, should be able to survive a flood of similar magnitude. In 1997, St. Norbert was protected by the Floodway. Under the conditions envisaged by Booy (1998), the Floodway would be inadequate, and St. Norbert will be inundated. Expanding the capacity of the Floodway is being examined as a possible solution to the scenarios.

The recovery effort restored a high level of functioning to Grand Forks and East Grand Forks. In some ways the communities were improved as a result of recovery assistance they received. In other ways the recovery assistance fell short of fostering long term

resilience. Although hundreds of residences were permanently removed from the 100-year floodplain in Greater Grand Forks, the 100-year and 500-year floodplains are still heavily developed. The expected protected dike (i.e., levee) will certainly relieve flood worries, probably for many years, but there is still potential for damage when river discharges overtop the dike, or if the dike is breached. This is particularly true in light of the local perception that the dike “solves” the flood problem and takes away the risk. This idea, and the fact that the flood hazard area designation on the regulatory maps would be removed from the true 100-year floodplain area after the dike is built, will doubtless act to discourage any backup mitigation. There is little doubt that the flood insurance purchase requirement and the building regulations currently in place for the flood hazard area will be dropped at that time. Further, a large majority of the housing in the area consists of homes built on basements, and these were repaired and refurbished en masse with recovery assistance received. There they sit, at risk and mostly uninsured.

This study finally puts forward the following recommendations that, if enacted, will increase resilience in the Red River Basin. Some of the recommendations are jurisdiction-specific, others apply Basin-wide. Recommendations for Canada include: (i) review and improvement of the delivery of assistance programs are required; (ii) consideration should be given to the establishment of an insurance scheme that would make affordable flood policies available; and (iii) a national mitigation strategy, accompanying broadly defined mitigation program, should be established. Recommendations for the United States are: (i) different ways to increase policy coverage under the National Flood Insurance Program should be considered; and (ii) a more thoroughly integrated approach to mitigation activities should be developed and adopted. Red River Basin-wide recommendations that stemmed from the analyses of this study are: (i) policies and programs that permanently remove structures from floodplains should be promoted; (ii) recovery, rebuilding, and mitigation expertise and information should be shared across the border; (iii) an ongoing monitoring system for resilience levels should be established in the Basin; (iv) the way in which currently defined levels of acceptable flood risk relate to long-term

resilience needs to be examined; (v) non-governmental organizations involved in recovery operations should be encouraged to consider how their practices affect resilience and modify them accordingly.

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