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The Red River Flood Of 1997: The Role Of Government Agencies In The Flood Plain

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THE RED RIVER FLOOD OF 1997:

THE ROLE OF GOVERNMENT AGENCIES IN THE FLOOD PLAIN

by

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This thesis, submitted by Deborah Pawley in fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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ABSTRACT

This study attempts to identify the roles of three federal agencies in the Grand Forks Flood of 1997. The three agencies were selected for the scope of their impact on the disaster as well as their impact on the community. The United States Army Corps of Engineers, National Weather Service, and Federal Emergency Management Agency contributed either to the the attempts to prevent flooding or flood recovery or both.

It is appropriate to determine both the physical factors that cause flooding and the agency policies that govern the ways in which people cope with disaster because these two are intricately linked in the ecosystem of the flood plain. The Grand Forks case study shows the connection between policy, land use, and the forces of nature.

The results of this research show that the concept of flood control at the local level must be woven into basin-wide management plans to be successful. The process is by nature political, so it requires leadership, accurate information, and public participation.

CHAPTER I

INTRODUCTION

Flooding on the Red River of the North in 1997 focused worldwide attention on the city of Grand Forks by topping the city's defenses and causing more than $4 billion damage (NWS, 1998). Months of snow and ice culminated in the most expensive natural disaster per capita in United States history (GFH, 1997). Thousands of residents evacuated the city and fire destroyed eleven downtown buildings. The burned-out structures of the central business district reflected in three feet of floodwater made a very dramatic scene for the media, but the true scope of the disaster only was realized as people returned to their homes after the flood water receded and the recovery began.

The purpose of this thesis is to identify the interactive roles of government agencies in what is locally known as the Flood of 1997. It is not to find fault with any particular person, plan, or agency, but simply to identify the roles of each agency in managing and mitigating the disastrous consequences of living in a flood plain. Locally elected officials, state agencies, and federal government programs all influence the development of land in the Red River Valley (FEMA, 1998). Three federal agencies, the State of North Dakota and the City of Grand Forks combined their efforts to prepare defenses, survive the disaster, and begin the recovery.

Federal Agencies Involved

Federal programs work at the local level through incentives that qualify local governments for federal money in various ways. The Federal Emergency Management Agency (FEMA) is a primary example of this practice in action. By requiring local

governments to maintain building restrictions in designated flood plains, FEMA limits development with subsidized insurance policies. In 1997, the agency had over 100 programs available for response and recovery in natural disasters.

The primary responsibility of the United States Army Corps of Engineers (USACE) is maintaining the navigable waterways of the United States. They also have responsibility for building levees and dikes along those waterways. The feasibility of these projects usually is determined by a complex analysis of cost-benefit ratio and those costs are then distributed among participating local governments (Moore, 1989).

The third agency with considerable impact on the community response to natural disasters, the National Weather Service (NWS), operates as a division of the National Oceanographic and Atmospheric Administration (NOAA). Its mission is to forecast weather events and river levels; the latter is done through a relationship with the United States Geologic Survey (USGS). The accurate forecast of hazardous events has saved lives, plus made it possible to prepare defenses for property in the path of disaster (Pearson, 1999).

Local Government

Local city government control over flood plain management uses economic development incentives to attract employers and new residents. Grand Forks works in conjunction with the state government on a regional approach to economic growth (Owens,1998). Local governments also must implement the programs of larger government agencies, because it is the great affinity of local officials for the areas that they represent that makes these programs effective. While federal regulations in flood plain management can inundate local officials with restrictions and deadlines (ASFPM, 1996), these officials are mandated to represent their citizens and make decisions in the best interests of public safety.

Information Available

The search for information on the Flood of 1997 began in January 1997 when neighbors began talking about spring floods even before the first NWS warning was issued. A system of organization that seemed to be naturally in place came to life in March as Sandbag Central operations began to recruit volunteers to make millions of sandbags to defend the city in the coming weeks. City Hall held open houses to provide flood-fight information to the public and elevation information to homeowners. Everyday the Grand Forks Herald printed the river levels along the length of the Red River and its tributaries. Local businesses released employees to make sandbags and other preparations for the flood fight. High schools in the surrounding counties sent busloads of teen-aged students to help elevate the city's defenses, and local high schools canceled classes to make additional manpower available as the water in the Red River continued to rise. When the residents of Grand Forks were needed on the river, the Grand Forks Air Force Base took over the daily operation of Sandbag Central. The seamless coordination of the flood fight was impressive to witness.

In the aftermath of the flood, as an evacuee, information about the flood again came into primary focus. The Emergency Operations Center (EOC), the source of all official information, broadcast daily briefings on local television station WDAZ. Their news crews taped hours of footage from running a boat through the neighborhood streets to broadcast the water level at individual properties. During that first week, with residents evacuated but safe, the single question was "What about my house?" Later, after residents were allowed to return, the scope of necessary information expanded to include city services, business activities, clean up, and school schedules. That information eventually led to the subject of money.

Federal money, state money, angel money, and personal savings combined with charity organizations and corporate donations to get the recovery underway while a complex network of local, state, and federal agencies administered the programs and policies designed to provide emergency assistance to the disaster area. This interaction between public and private agencies was essential to the effectiveness of the programs.

The Angel money, a $15 million anonymous gift, was distributed almost immediately to residents of Grand Forks without naming the source of the money. Two thousand dollars per household helped many families and individuals to find food, clothing and a place to live while the future of their city remained in doubt.

The information for this study came from the agencies themselves through public documents and web sites. The Special Collections at the Chester Fritz Library at University of North Dakota, Grand Forks Public Library, Information Center in City Hall at Grand Forks, and the Natural Hazards Library at the University of Colorado in Boulder also provided valuable sources.

The Information Center at Grand Forks City Hall provided data which I used to generate two maps of the city. The land use codes are determined by the city planning office, while the tax assessor's office determined the extent of damage at each property in the city tax base. These maps were assembled in ArcView 3.1 in the Geography Department computer lab and printed at the Upper Midwest Aerospace Consortium in Clifford Hall.

Limitations of the Research

A significant amount of information for this project was unavailable for a variety of reasons. The original concept for this research was to compare the EOC documents for several flood years to establish changes in the city approach to floods, but those records were

in the EOC, located in the basement of the Police building, on Fifth Street, at the time of the flood and were destroyed (Mulhern, 1998).

While damage estimates are widely available, the actual damage is more difficult to determine or define. Individual property owners each combined available funding with available manpower to "get back to normal" in extremely individual circumstances. These records are considered to be private financial information, and it was not available at this time.

Time is also a limiting factor in this research. While memories are still fresh, data is not complete. Even the exact location of the proposed permanent dike line is still embroiled in controversy. For this reason, the report is written from a largely qualitative rather than quantitative perspective.

The literature review in Chapter 2 provides perspective and context for considering the impact of government agencies on flooding. In Chapter 3 the history and development of three federal agencies is summarized with respect to the development of flood control policy in the United States. Chapter 4 presents a case study of Grand Forks during the Flood of 1997, which brings the work of national agencies into focus at the local level. The data discussed in Chapter 5 was obtained from the City of Grand Forks and shows the impact of the Flood of 1997 on the city tax base. The final chapter of the thesis contains a few conclusions and includes some of the controversy that is inevitably part of the recovery process.

CHAPTER II

LITERATURE REVIEW

The literature of flooding and the physical and climatic factors that affect flooding in all parts of the world is large indeed. The review presented here represents the political involvement of various international organizations and government bodies at all levels in sharing information and raising awareness of the dangers of catastrophic floods, as well as the recent opinions of local experts in the Red River Basin that were presented at the North Dakota Academy of Science.

Natural Hazards

The International Decade for Natural Hazard Reduction began in 1990 by recognizing the need to reduce the devastating impact of natural disasters worldwide. Heavy losses at the hands of nature are not inevitable even though nature throws some extremely devastating punches from time to time. Hazard reduction refers to the process of minimizing the impacts of a potential event on the social and economic fabric of the community.

Natural hazards research is the study of the dangers that threaten human habitation within specific regions (Chapman, 1996). Natural hazards include storms, floods, earthquakes, and fire. These rapid onset hazards occur suddenly and differ greatly from long term hazards of drought, plague, and desertification. Grand Forks' history of flooding makes it a "natural" study area for hazard mitigation research.

Global Approach

A worldwide approach is necessary in view of the fact that natural hazards do not respect national boundaries. Progress has been made in developing mitigation strategies, but

the application of new strategies require experience and access to critical data that may be unavailable (IDNHR, 1990). If nothing is done, hazards will continue to be increasingly severe.

The Selected Natural Disasters of This Century in Appendix G shows the impact of natural disasters on a global scale as well as their increasing frequency and rising death tolls. There is no geographic preference or exemption for any region of the world. Virtually every country is at risk and all can benefit from the knowledge gained by each tragic experience.

The approach to mitigation is both physical and cultural. Engineering efforts that are effective in one area may not work in another part of the world, and restrictions on land use that make sense in America may not be applicable in a more densely populated country, such as Japan. Several case studies included in the National Research Council's report in 1987, Confronting Natural Disasters, show that the solutions to mitigation issues depend on a broad range of factors that include scientific, technological, political, and demographic characteristics of each region.

Building practices, for example, are changing rapidly around the world. Engineering developments that meet safety requirements in one area can make it possible to build in otherwise dangerous locations. Structural reinforcements designed to provide better protection are not verified until after a disaster. These conjectural improvements often are misunderstood when applied in other regions (IDNHR, 1990).

Flood mitigation techniques have developed throughout time and are tested continuously by changing climate patterns and the ever-increasing intensity of land use by a growing world population. Farming, deforestation, and urbanization all serve to increase runoff and exacerbate flooding (FEMA, 1995). The natural flooding of river systems is transformed into a natural disaster by reckless building and poor land management practices.

United States National Mitigation Strategy

Nationwide response to natural disaster is summarized in this quote from President Clinton, "Mitigation is about lowering the risk and reducing the effects of disasters, . . . To successfully mitigate against disaster will require the combined talents and concerted efforts of all levels of government, academia, professional and voluntary organizations, the corporate sector, and all Americans. . . the time has come to mount a nationwide effort focused on reducing the impact of disasters as well as reducing their economic consequences" (FEMA, 1995).

The United States suffered 219 federally declared disasters between 1989 and 1994, costing the federal government over $34 billion. The National Mitigation Strategy has been developed with two goals to be reached by the year 2010: to substantially increase public awareness of natural hazard risk and to significantly reduce the risk of loss of life, injuries, economic costs and destruction of natural and cultural resources that result from natural hazards.

Historically, floods have been a factor in 80 percent of all declared disasters in the United States. The national strategy for mitigation has evolved from reliance on structural measures to an emphasis on local land use planning. The National Flood Insurance Program (NFIP) was established in 1968 to provide subsidized insurance to communities enforcing flood plain management guidelines in accordance with the federal objectives. In 1973, legislation made flood insurance mandatory for mortgage loans on property within a flood plain. An executive order issued in 1977 requires federal agencies to undertake a planning process prior to any actions taken in or impacting on flood plains. The National Flood Insurance Reform Act, signed into law following the Mississippi River floods of 1993, established a grant program for local mitigation planning projects.

Local Government

The major dilemma for public officials at the local level is planning for future floods (ASFM, 1996). Awareness of flood risk is not usually well known unless there has been recent flooding, and the effectiveness of prevention is historically difficult to quantify. Almost every community in the United States is vulnerable to the impacts of natural disasters. With more than 18,400 cities participating in the NFIP, the need for responsible flood plain management is well recognized, but the process is complex.

Local officials must identify opportunities to enhance their communities by recognizing the proper use of flood plains. Typically, several city government departments will have related responsibilities that affect decisions about economic development, recreation, urban renewal, and emergency response. For local officials it is necessary to balance outside assistance provided by state and federal agencies as well as private consultants in order to find the best solutions for each community (Owens, 1998). Coordinating the efforts of so many well-intentioned groups can be time consuming with the rewards only realized after the inevitable next flood.

Local officials are at a disadvantage in flood plain management because their jurisdiction is only one part of the entire watershed. The most effective approach to flooding in a river basin is a watershed approach to the issues that create floods. Elected officials generally find themselves on numerous boards that deal with a variety of water issues (Belford, 1999).

Regional Experts

Several papers on the geomorphology of the Red River Basin and the Flood of 1997, including opinions of agency managers and academic professionals, have been presented at the North Dakota Academy of Science 89th and 91st Annual Symposiums. These papers

describe the factors that affect flooding, the management plans that are needed, and the status of flood control on the Red River.

John Bluemle of the North Dakota Geologic Survey clearly defines the constant factors that affect flooding as the direction of flow, flow velocity, channel gradient, drainage ditches, road systems, bridges, and urban growth. Variable factors are largely climatic including snow accumulation, depth of freeze, soil moisture, thaw rate, and ice thickness. According to Bluemle, all these factors contributed to the Flood of 1997. In addition, he discusses the drawbacks of reliance on structural control for mitigation. Floods happen when precipitation exceeds the ability of the river to carry the runoff. We must understand all the factors that affect floods if we hope to control the impact of flooding.

Leon Osborne, Jr., at the Regional Weather Information Center, University of North Dakota, wrote an overview of the winter conditions in the season preceding the Flood of 1997 saying the annual variability of weather determines the extent of flooding. The wet cycle that began in 1993 continues, reducing the capacity of the Red River Basin to store additional precipitation. The winter of 1996-1997 exceeded many previous weather records.

Table 1. Winter blizzards prior to the Flood of 1997.

16-17	November	1996
15-18	December	1996
20-21	December	1996
3-4	January	1997
9	January	1997
22	January	1997
4	March	1997
13	March	1997
4-6	April	1997

Heavy precipitation on the Red River and its tributaries soaked the ground and temperatures remained below freezing through February. The snowfall accumulation set new records and contained unusually high water equivalents. The April Blizzard, "Hannah," had a

central pressure of 974 mb and the tight pressure gradient generated winds of up to 80 mph. Warm air held aloft and freezing temperatures at the surface produced dangerous freezing rain and ice accumulations across the valley.

F. Larry Leistritz presented a paper summarizing the socioeconomic and land use trends in the counties that comprise the Red River Valley. Over the past twenty years employment has improved while the area of land in farms has remained constant. Two-thirds of the 34.8 million acres in the Valley are used for agriculture. Interestingly, one significant trend has been an increase of 71% in the acres of irrigated land, however that increase represents only a total of 1.1% of all crop land harvested in the basin.

The proceedings of the North Dakota Academy of Science included several professionals presenting papers on planning for water management in the Valley. Gale Mayer's paper makes the case for involving scientists in reassessing the needs of the Red River Valley with the new perspective created by the Flood of 1997. The Red River Water Management Consortium at the Energy and Environmental Resource Center proposes to address eight points of concern: causes of the Flood of 1997, flood forecasting, public education, potential of Devils Lake, flood hazard mitigation options, environmental impacts, infrastructure, and economic impacts.

Dexter Perkins wrote of the struggle to implement the non-structural elements of flood control. Even though more than 200 flood control dams have been built in the Red River basin, these structures did little to affect the Flood of 1997. The flatter the land, the more effective wetlands are when used for flood protection. Pembina, Grand Forks, Traill, Cass, and Richland counties have lost over 90% of their wetlands. On the North Dakota side of the Red River Valley the total loss of wetlands is approximately 6 million acres. That is roughly 5 million acre-feet of water that would not be moving through the basin during a

peak flood, but it is almost always more profitable for the land owner to use wetlands for any other purpose than it is to devote the land to water storage.

Leroy Klapprodt presented a plan for updating the North Dakota Water Resources Management Plan that included public input over thirteen months to identify goals and objectives for water programs that will meet the needs of the long term needs of North Dakota residents.

Gene Krenz introduced the Red River Basin Board as a non-profit corporation dedicated to wise water management. The 21-member board includes representatives from North Dakota, South Dakota, Minnesota, Manitoba, and First Nation delegates. The charter meeting in July 1997 stated that the overall mission of the RRBB is to develop and implement a comprehensive water management plan in the Red River Basin as well as to help facilitate the resolution of interjurisdictional issues.

Thomas Moe delivered an update on the Red River Water Management Consortium established by the EERC in partnership with the USDA, state and local agencies, municipalities, and industries that rely on the resources of the Red River. The work of the RRWMC is funded by federal grants and membership fees with research and development tasks directed by the members. The research provides scientific data needed to make educated decisions with a basin wide perspective.

A paper from Kadrmas, Lee & Jackson in Bismarck presented some very specific numbers for a concept that has been dubbed "the Waffle" in which the existing square mile road grid would be used to reduce the spring runoff by 35 % by using 700 sections for 5 to 10 days during the time of predicted crests, benefiting the entire region rather than cities only.

Roger Hollevoet of the USFWS raised the issue of coordinating the activities of the multitude of planning organizations currently developing water management strategies on

every conceivable government level. His concept of conservation agriculture could start communities and landowners working together toward a multipurpose approach to water management issues.

David Loss provided a status report on the activities of the USACE in the Red River Valley. Updating the rating curves at virtually every point on the main stem of the river and recalibrating the models with the new data from the Flood of 1997 is underway and funded by FEMA. A mediated agreement has resolved environmental disputes involving the Minnesota Department of Natural Resources, Red River Water Management Board, United States Army Corps of Engineers, United States Fish and Wildlife Service, National Audubon Society, Minnesota Center for Environmental Advocacy, Minnesota Pollution Control Agency, and Minnesota Board of Water and Soil Resources that blocked many new impoundment projects. In Grand Forks, the Corps is completing the General Reevaluation Report that will recommend 26 miles of permanent levees, floodwalls, and road raises in combination with smaller diversion projects and the removal of the downtown pedestrian bridge. A synopsis of Corps activities throughout the valley is included in the paper for the NDAS.

According to Todd Sando of the North Dakota State Water Commission (NDSWC), the physical characteristics of the Red River make flooding inevitable and urban development has compounded public exposure to devastating flood losses. The crest levels in 1997 exceeded previous levels at every gaging station on the main stem of the river. North Dakota has 18,982 square miles that drain into the Red River or 52% of the United States portion of the basin. While Minnesota tributaries were flooding in advance of those on the North Dakota side, those smaller communities were devastated early and other towns located downstream had time to prepare. The West Fargo diversion apparently saved Fargo from the

fate suffered by Grand Forks in 1997. The English Coulee diversion helped prevent serious damage in the western parts of Grand Forks.

The Lake Traverse reservoir in South Dakota became quite controversial when water released from the reservoir to protect the integrity of the dam was seen as a contributing factor to the damage in Grand Forks. Their policy is not to release water after the river stage at Wahpeton reaches 12 feet unless the reservoir level reaches 981 ft MSL when the dam could fail. Reservoir management helped to minimize damages in the southern end of the valley.

John Towle presented the concept of Consensus Building among rural residents. His success with management issues on the Pembina River focused attention on a four step process that can address complex issues: assessment, getting started, running the process, and monitoring the results. Taking time at the beginning of the process to identify and include all the interests of the basin, will help to insure support for whatever plan has been developed. No plan, under any circumstances, can succeed without local support for the project. The consensus process is time consuming, but it is necessary for the sustainable resolution of water management issues.

These authors and others represented in the table of presentations at the North Dakota Academy of Science contribute valid points to the discussion of future flood mitigation on the Red River of the North.

Table 2. Presentations at the North Dakota Academy of Science.

Name	Agency	Subject
Gale Mayer	EERC	Science in Management Decisions
Ken Harris	MGS	Geologic Setting of the Red River Valley

John Bluemle	NDGS	Factors Affecting Flooding
Terry Zien	USACE	Unsteady Flow Models
Leon Osborne	UND	Red River Valley Winter of 1996-97
Todd Sando	NDSWC	Flood of the Century and Flood Management
Dexter Perkins	UND	The Hard Path and The Soft Path to Flood Protection
Frank Bevecqua	IJC	Preventing and Resolving Disputes
Joseph Hartman	UND	The Ever Present Chance of Flooding
David Loss	USACE	Status of Flood Control Activities in the Red River Valley
LeRoy Klapprodt	NDSWC	State Water Management Plan
Gene Krenz	RRBB	Management Plan Status
Thomas Moe	EERC	Update on the Red River Water Management Consortium
F. Leistritz	NDSU	Socioeconomic and Land Use Trends
John Towle	Canada	Consensus for a Sustainable Future
Roger Hallevoet	USFWS	Comprehensive and Multi purpose Approach to Watershed Management
Gerald Groenewold	EERC	The Waffle
Will Grosnold	UND	Estimating Flood Recurrence
Wendy Pearson	NWS	Procedures and Assumptions in Flood Forecasting

The North Dakota Quarterly (Vol. 65, No. 4, 1998) contained additional viewpoints on the Flood of 1997 that included photos and interviews, as well as physical and historic perspectives. Dr. John Anderton's paper on the Red River Valley prior to settlement cites first-hand accounts of the pre-American landscape to establish the role of human impact on

the prairie prior to western settlement. Dr. Paul Todhunter examined flood risk using Grand Forks as a case study that describes the factors affecting flooding, the conditions at the time of the Flood of 1997, and includes aerial photos of the flood from KBM, Inc, in Grand Forks. Dr. James McKenzie interviewed Mayor Pat Owens in September of 1997 and summarized their conversations about the flood, the people, the media, the politics, and the angel donation to Grand Forks. Dr. James Mochoruk, a lifelong resident of the Red River Valley, wrote a very personal perspective exposing the emotions of flood fighting and the arrogance of thinking that the flood could not happen and will not happen again. Dr. Glinda Crawford examined the current connection of residents to the tallgrass prairie and found it to be tenuous at best. In a review of Many Voices of the Boulder Creek Watershed for NDQ Dr. Crawford introduced several questions concerning watershed awareness in regard to the issues of flooding in the Red River Valley. This NDQ also contains a collection of flood graffiti contributed by Dr. Morton Ender, et al with an explanation of rubbernecking and how it can be useful to academic endeavors.

The international effort to reduce the risk of natural hazards has created greater awareness of emergency measures that can be effective and the regional authors represented here have contributed to a better understanding of flood conditions in the valley by writing about the physical conditions that exist today. The next chapter will examine the development of the federal agencies involved in local flood plain management.

CHAPTER III

GOVERNMENT AGENCIES

An archival search of relevant materials revealed the history of flood response and disaster readiness in the study area. Government involvement at all levels is documented in studies and reports by various agencies that are generated after a major flood event in the valley. However, there are some serious gaps in the documentation at the local level since flood damage almost always includes the loss of documents stored in downtown basements of public buildings.

Three federal agencies were chosen based on their direct participation in the 1997 flood response and subsequent recovery process in Grand Forks. Information available on government web sites provided history and activity for each of the agencies. Some documents and literature cited were loaned graciously to me by the Natural Hazards Library at Colorado University in Boulder, Colorado. Interviews with participating officials helped to give perspective to the interaction between agencies at all levels.

The federal agencies chosen for study in this thesis are the Federal Emergency Management Agency (FEMA), the United States Army Corps of Engineers (USACE), and the National Weather Service (NWS). Each of these has had considerable influence on local decisions and perceptions prior to the Flood of 1997, during the emergency response, and in the recovery process that followed.

In Grand Forks, these three federal agencies had significant involvement in the preparations and response to the Flood of 1997. The United States Army Corps of Engineers (USACE) is responsible for structural mitigation of floods. The National Weather Service

(NWS) forecasts both the danger of storms and the danger of flooding. The Federal Emergency Management Agency (FEMA) controls the flood plain through zoning and insurance regulations. These three agencies provide information to the local government in order for them to make plans and decisions in the best interests of the city.

United States Army Corps of Engineers

It is important to know how the policies and practices of the U.S. Army Corps of Engineers (USACE) have evolved from construction of military fortifications to the current mission as the primary agency for flood control in the United States. A long and complex combination of flood disasters and politics has positioned the USACE to make a substantial contribution to national prosperity and public safety. The Office of History, Headquarters, U.S. Army Corps of Engineers commissioned a book to study the relationship of the USACE to the development of flood plain management programs in the U.S. That book by Moore and Moore was published by the University of Colorado in 1989 and is the primary source of the material presented here.

The history of the U.S. Army Corps of Engineers, known in the Army as simply "the Corps," dates back to 1802 when it was organized to construct fortifications. In 1824, the General Survey Act authorized the use of Army engineers to make plans for improvements on the Ohio and Mississippi Rivers, but federal funding was not provided. In 1850, two reports disagreed on the methods needed to control flooding. It was determined by C. Ellet, Jr., a civilian engineer, that the growing number of settlers occupying the flood plain caused flooding on the lower Mississippi. His report to Congress proposed that a combination of levees and headwater reservoirs be constructed while, at the same time, the Corps survey by Cpt. Humphries and Lt. Tallbot backed the completion of a levee system alone. The Mississippi River Commission, created in 1879 by Congress, chose a levees-only approach to

control flooding using the premise of insuring navigation as the authority for federal control of the project.

At the turn of the century, political interest in hydroelectric power for the east and water supply for the arid west lead to the greater involvement of the Corps in large dam projects. The Rivers and Harbors Act of 1899 gave the Corps regulatory control over the construction of bridges, dams, and levees on the navigable waterways nationwide. The Corps position was that any and all benefits from development were secondary to the primary mission of maintaining navigation.

President Wilson ordered an investigation after flooding on the Ohio River killed 415 people in 1913. That board visited 52 cities and concluded that no single flood control measure is sufficient because conditions inevitably vary from one basin to the next within the system. They also concluded that most damage was caused by the "unregulated encroachment on the flood plains" and endorsed the idea of moving valuable property beyond the flood plain. Passage of the Flood Control Act of 1917 finally put flood control on an equal level with navigation in the mission of the Corps.

The fundamental concept of controlling floods with engineering was accepted with the passage of the Flood Control Act of 1928. Even after the Mississippi floods in 1927 had covered 20,000 square miles, destroyed 137,000 buildings, killed 200 people and made 700,000 others homeless, the only question was that of funding the engineering proposals with federal or local sources.

Severe flooding in the spring of 1936 both in New England and in the Ohio River Valley led to additional federal legislation. The Flood Control Acts of 1936 and 1938 created a national program for flood control in the United States based on three structural solutions: levees, reservoirs, and channel improvements with one additional provision for evacuations.

Opposition to these acts came from the prevailing opinion that engineering alone was not enough to control floods.

Gilbert F. White's dissertation work in the 1940s provided a wider view of flood control measures. He said that land use planning might become an effective method of reducing flood damages (Moore, 1989). Specifically,"in some flood plains, change in location and structure of buildings or modification of farming systems may yield net gains greater than those from control or preventative (flood) control works." By 1955 these ideas had been accepted as valid measures for flood control in Hoyt and Langbein's study, "Floods."

During the first half of the twentieth century, the United States had experienced floods with damages in excess of $50 million only eight times and yet that damage figure was reached or exceeded ten times between 1940 and 1960. The reclamation of the flood plains had in fact put more property at risk (Moore, 1989).

The Bureau of the Budget issued Circular No. A-47 in 1952 giving the Corps its first tool to consider land use management in flood control projects. Initially, zoning restrictions were seen as contrary to the concept of increasing the national economy; however, these alternative methods had to be considered in view of the rising cost of construction projects and escalating damages.

Meanwhile, through his work with the Tennessee Valley Authority (TVA) in the 1930s, James Goddard was able to demonstrate that land use decisions made at the local level did have a positive effect on mitigating flood damages. The TVA flood plain management planning provided detailed information to the communities requesting assistance but left decisions to be made at the local level. With this approach; zoning regulations, building

codes, and financing could be used to control development in each community (Moore, 1989).

After a hurricane caused severe damage in 1956, the United States Senate asked the Corps to make a comprehensive study of the Delaware River basin. The Corps became the lead agency coordinating the participation of other federal agencies, state, and local governments in order to generate a plan for water resources that included provisions for flood protection, water supply, power, recreation, and pollution control. As multi-objective planning came into prominence, the Corps role in development needed to be redefined.

The Harvard Water Project, previously organized by Arthur Maass in 1951, brought academics and various agency employees together to examine water resource systems. The Project included senior people in the Corps, the Soil Conservation Service, the Bureau of Reclamation, the Forest Service, the U.S. Geologic Survey, and state planning commissions. Their work produced economic and engineering analyses, procedures, measures, and evaluation strategies that combined mathematical modeling and simulation. These practices were used to produce a 26-volume report in 1960 that assessed all projects in relation to economic development and environmental quality in the Appalachian region.

Also, Gilbert White was working with Francis C. Murphy at the University of Chicago to develop a systematic method to collect and distribute flood data to the various agencies involved in flood plain management (Moore, 1989). Murphy said, in 1958, that comprehensive risk reports should include: 1) a topographic map of the flood plain; 2) the extent of various frequency floods; 3) river profiles; 4) channel cross sections; 5) flood frequency curves; 6) aerial photographs; 7) hydrographs of the floods of record; and 8) information on the value and type of property at risk. The Corps was positioned to provide this information and Congress granted in Section 206 of the Flood Control Act of 1960

authorization for the Corps to spend $1 million annually providing technical advice for local planning. Only six years later that figure was raised to $7 million to strengthen the Flood Plain Information Services Program.

After the White Task Force report (1958) attacked the cycle of protection and encroachment developed by the Corps, Goddard tried to reorganize the Flood plain Management Services Program (FPMSP) within the structure of the district offices. He concluded that the largest part of the Corps responsibility was not in providing the necessary reports but in making sure that the information was used. However, his plans for FPMSP were not effectively implemented and so the Corps continued to approach flood issues from a structural perspective.

Two projects focused the debate between environmentalists and engineers in the 1960s as each came to opposing views concerning two proposed dams: the Kinzua dam project on the Senecca Reservation in Pennsylvania; and the St. Croix River dam to be located ten miles above the falls creating a 30 mile lake along the Minnesota-Wisconsin state line. Despite the six alternative designs provided by Arthur Morgan to preserve the treaty rights of the Senecca Tribe, the Corps went ahead with its original and cheapest plan for the Kinzua project. The St. Croix River eventually was protected from the Corps' dam proposal by listing it as one of the first eight rivers, passed by Congress in November 1968 (Moore, 1989). When Congress passed the National Environmental Policy Act of 1969 which required an environmental impact assessment for every proposed federal project, the Corps leadership realized that changes were needed for the entire organization.

Engineer Circular 11 65-2-86, National Environmental Policy Act of 1969 explained the ways in which the Corps would comply with the new policy in the 1970s. The Chief of Engineers, Lieutenant General Frederick Clarke, emphasized the need to reflect a

professional, objective approach in the evaluation of environmental concerns. Director of Civil Works Major General Francis Koisch recognized the need to weigh environmental factors more carefully when decisions are made.

Two reports issued in 1973 caused the Corps to re-evaluate its planning process. The National Water Commission report, Water Policies for the Future, recommended that new policies had to be developed, and the Water Resources Council's report, Principles and Standards for Planning of Water and Related Land Resources, outlined a new method of evaluating economic and environmental aspects of development projects. In 1974, the Water Resources Development Act required equal consideration of structural and non-structural alternatives, but the Office of Management and Budget (OMB) refused approval for cost-sharing of projects that included nonstructural flood control measures because land use management was the normal responsibility of the state and local governments. With federal funding for structural solutions and no funding for non-structural approaches, local governments continued to choose the former (Moore, 1989).

President Carter issued two executive orders in 1975 that addressed flood plains and wetlands recognizing the natural benefits of protecting both and reducing flood damages. These guidelines established the 1% chance flood as the level to be used for planning purposes. Every year there is a 1% chance of a flood that reaches a specific level and that level is known as the 100-year flood. In 1979, A Unified National Program for Flood plain Management provided general guidance for decision-making at all levels of government and recommended strategies for flood loss mitigation.

President Reagan's Cabinet Council on the Environment looked at the issue of cost sharing in 1982 leading to a consensus for the 1986 Water Resources and Development Act that defined the cost share structure for the entire country. Even with funding for land use

alternatives, construction projects remained the most popular choice for political and for emotional reasons. The physical presence of a structural solution provides a focal point for local politics and a sense of security for the taxpayers while non-structural measures such as zoning and insurance can be difficult to "see" in the landscape of the flood plain.

The first Corps project in the Red River Valley was the Lake Traverse Dam built in 1948. It was quickly followed in 1951 by the Baldhill Dam located upstream from Valley City, North Dakota. The Orwell Dam on the Otter Tail River in Minnesota was built in 1953 to help provide water storage and flood control in the Red River Valley. The map in Appendix F shows the location of structural improvements throughout the basin. The dots indicate flood protection and the thick lines show the length of channel improvements along tributaries and the main stem of the Red River (Krenz, 1993).

National Weather Service

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States to protect life, property, and the national economy. The NWS is the sole voice of the United States government for issuing warnings during life-threatening weather situations including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and other destructive climate events. President Grant created the Service in 1870 when a joint resolution of Congress authorized the Secretary of War to use observer sergeants of the Army Signal Service. The weather agency operated as a part of the Army until 1891 when it became part of the Department of Agriculture. The Weather Bureau issued weekly outlooks for agriculture until 1940 when it moved to the Department of Commerce in support of the aviation industry.

In 1970, the Bureau was renamed National Weather Service and made a part of the National Oceanic and Atmospheric Administration. Technology is the key to the NWS

forecast capability. Data from Earth-orbiting satellites is combined with automatic weather reporting information stations and observer information. Complex computer models process this data as well as that gathered by the United States Geologic Survey to produce forecasts, weather warnings, and river stages.

Wendy Pearson's paper at the North Dakota Academy of Science in 1999 for the National Weather Service deescribes the river basin model as three separate models: one for snow, one for rainfall and runoff, and one model for the river flow. The flow model compiles data from the other two with unit hydrographs, mean discharges, and established routing techniques to produce forecasted discharge. That discharge is converted to river stage level using a rating curve. The Red River of the North forecasts come from the North Central River Forecast Center in Chanhassen, Minnesota.

The information is used by the NWS to produce long range outlooks in narrative or numerical form. The narrative describes the conditions present and the potential for flooding while it assumes that normal temperatures and precipitation will prevail. Numerical outlooks are issued to indicate the expected crest level under two conditions: no additional precipitation or normal precipitation. The Table in Appendix G shows that the observed crest is almost always within the range of the crest forecast.

The National Weather Service had a major role in the Flood of 1997 since weather conditions in the winter exceeded any previous records in the valley (Osborn, 1997). According to the event overview prepared by the NWS, the valley received 4 inches more rain than normal in the fall of 1996. This saturated the soil as deep as five feet just prior to the freeze. In mid-November of 1996 the temperatures dropped to –20°F and stayed below zero until late in February of 1997 while eight blizzards distributed 100 inches of snow

throughout the valley. At the beginning of the melting period, the NWS estimated 10 inches of snow water equivalent on the ground when the ice storm arrived on April 5th.

The National Weather Service received the Silver Medal from the Department of Commerce for their efforts to forecast the storms and floods of 1997 resulting in no loss of life.

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) was created by President Carter in1979 to consolidate the various programs that provide emergency services for the victims of natural disasters. In that executive order FEMA absorbed the responsibilities of more than 100 agencies involved in some aspect of disasters, hazards, and emergencies.

The FEMA web site traces the government history of federal support for disaster recovery to the Congressional Act of 1803 which provided assistance to a New Hampshire town after an extensive fire. In the next 100 years the United States Congress passed more than 100 pieces of legislation in response to hurricanes, earthquakes, floods, and other natural disasters.

After the stock market crash in 1929 and the Great Depression that followed, the federal approach to everything became popular in "New Deal" politics. During the 1930s, the Reconstruction Finance Corporation was given authority to make disaster loans for public facilities, the Bureau of Public Roads began to provide funding for disaster damage to roads and bridges, and the U.S. Army Corps of Engineers' flood control mission was established by the Flood Control Act of 1936.

Hurricanes that struck the United States in the 1960s focused attention on the damages of natural disasters and prompted more legislation which included the National Flood Insurance Act in 1969 that made flood insurance available to homeowners in the 100

year flood plain. It was available only in communities that enact flood plain regulations for land use. In 1974, the Disaster Relief Act established the process of Presidential disaster declarations, but the assistance was complex and difficult to obtain in actual emergencies when time was often the most critical element of response.

As FEMA's first director, appointed in 1979, James Macy stressed the similarity of disaster preparedness to the previous programs in place for civil defense. The agency developed an Integrated Emergency Management System combining direction, control, and warning systems that are necessary for the full range of emergencies. The 1980s provided the new agency with the full range of disasters from Love Canal and Three Mile Island to the Cuban Refugee Crisis.

James Witt was named the new director of FEMA in 1993 and the 1990s became a period of change for the agency. The end of the Cold War allowed more resources to be devoted to disaster relief, recovery, and mitigation programs, and Witt streamlined the agency based on his previous experience as a state emergency manager. The International Decade for Natural Disaster Reduction (1990s) provided several significant tests for the agency including Hurricane Andrew's impact on south Florida in 1992, the Great Midwest Flood of 1993, and the Northridge Earthquake in January of 1994. President Clinton recognized the outstanding efforts of the Federal Emergency Management Agency in the State of the Union Address in 1995.

In 1998, the agency had 2500 employees and 5000 people on reserve to provide leadership and support to reduce the loss of life and property in all types of disasters. FEMA has reduced the administrative costs of disasters, and has forged close working relationships with state and local governments, industry, and volunteer organizations (FEMA, 1998). Two programs have been successful in addressing the need for flood hazard mitigation: 1)

increasing the number of flood insurance policies; and 2) the purchase of 20,000 properties voluntarily offered by owners to remove obstructions from the flood plains across the nation.

FEMA helps cities pay for the repair of public buildings and infrastructure on a cost-share basis. This is usually a federal share of 75% with the city share at 25%. The City of Grand Forks suffered damages to property and infrastructure estimated in excess of $189 million (GF Info Center, 1999). FEMA also provides loans through the Small Business Administrationand the Farmers Home Administration; cash grants are available to people who do not qualify for loans. Disaster Housing Assistance Programs provided temporary shelter with mobile home parks established as a temporary measure for the winter of 1997-1998 in Grand Forks.

Under the Direction of James Witt, FEMA has worked with other agencies to respond to 200 disasters, register two million Americans for federal disaster assistance, provide help to more than 4000 counties, and distribute $12 million in relief funds (FEMA, 1998). The FEMA Strategic Plan states their goals for the year 2000, "to change the emergency management culture from one that reactively responds to disasters, to one that proactively helps communities and citizens avoid becoming disaster victims."

This summary of the development of federal flood plain management and the three agencies involved over the previous century presents only a glimpse of the struggle to create a comprehensive nation-wide approach to flood mitigation. The pattern of settlement on the flood plain and the consequences can be seen in the case study of Grand Forks on the Red River of the North.

CHAPTER IV

CASE STUDY: GRAND FORKS FLOOD OF 1997

The City of Grand Forks prepares for flooding every year. The residents of this city are willing to fight for their property even against the force of nature itself. From the first settlers in the mid-1800s to the farmers who originally plowed the tallgrass prairies in the 1870s to the homeowners of the 1970s, residents have tried to control the spring runoff that is the major source of flood damage. The physical characteristics of the valley often are working against the people who make their homes within it.

Physical Characteristics

The Red River of the North is a relatively young feature created when the glacial Lake Agassiz finally drained into the Hudson Bay as the glacial age came to an end approximately 9000 years ago. As the glacier receded, the lake was created; as the lake receded, old shorelines were left behind. The previously deposited sedimentary layers became the soils of the tall grass prairie. The topography of the Red River basin has been described as a plywood board with three sheets of typing paper for bluffs (Howard, 1997). The Red River is more than 500 miles in length and it is the main stem of the drainage system for the 45,000 square mile Red River Basin. The total change in elevation from the headwaters to the United States border is 200 feet making the average gradient along the Red River of the North equal to six inches per mile (Bluemle, 1980).

The climate of the valley is extreme. The winter weather is the product of continental location, high latitude and low solar insolation, while in the summer, gulf moisture, carried north by the jet stream, creates severe thunderstorms. The procedings of the NDAS following

the Flood of 1997 contain expert commentary on the climate and conditions in the valley during the spring of 1997.

Cultural Landscape

Even with a short growing season, farming has dominated the valley since the railroads were built in the 1870s. Eighty per cent of the land in the basin is used for commercial agricultural production of wheat, sugar beets, and potatoes (Leistritz, 1999). Grand Forks was established as a trading center at the Forks of the Red River and the Red Lake River when the fur traders still used these rivers to move inventory and supplies between Winnipeg and St. Paul. In 1881, the railroad bridge was constructed connecting Grand Forks to the eastern markets and the growth of the city has continued ever since (Hampsten, 1995).

Flood History

Previous regional floods have been documented by early voyageurs and fur traders working for the Hudson Bay Company in Winnipeg. The largest of these was in 1826 when a deep snow pack melted quickly after a long winter. Samuel S. Harrison and John P. Bluemle describe the flood history of the Red River in great detail in an Educational Series for the North Dakota Geological Survey; Flooding in the Grand Forks-East Grand Forks Area, 1980.

The first river gage at Grand Forks was installed on the Railroad Bridge in 1882. Since that time, the Red River has reached its official flood stage of 28 feet fifty-seven times. In the thirty years prior to the Flood of 1997 the flood stage at Grand Forks has been exceeded twenty times with eight of those reaching 40 feet or more.

Phases of Disaster

The Flood of 1997 began with a sequence of climatic conditions in the fall of 1996, escalated in the face of eight winter storms, and culminated with a catastrophic natural

disaster compounded by raging fire in the historic downtown business district. These events have been well documented, but they are only the beginning of a long and complex process that includes immediate response to the flood emergency, damage assessment, emotional trauma, and the recovery of government, business, organization, and private property.

The first warning of severe flooding was issued on the 13th of February following the airborne survey conducted on February 6th. The specific meaning of "severe" is floods greater than the previous flood of record. The second warning was issued on February 27th in numerical form at the request of the USACE and that outlook called for river crests between 47.5 and 49 feet in Grand Forks. This enabled the Corps to begin flood protection construction well in advance of the expected crests and earlier than normally possible. During March, the airborne surveys continued and the flood forecast remained consistent at 49 feet with normal precipitation.

On April 3rd the river rose to a gage level of 18.1 feet and the next day it rose to 23.6 feet. On April 5th and 6th sandbaggers had to suspend their efforts to raise the dikes as Blizzard Hannah covered the valley with ice. The storm was the worst of the season knocking out power, light, heat, and communications in Grand Forks and the surrounding area. The storm increased the water content of the snow in the valley, but the NWS did not raise the forecast level until computer models could process all the new data gathered by the overflights that could not begin until after the storm had cleared. People in Grand Forks still had every reason to think that they could still win the Flood Fight of 1997.

After the blizzard, the river level had reached 35.7 feet, a change of more than 17 feet in only three days. Another survey of the snow pack was conducted from April 9th to the 12th while the NWS continued to call for a peak stage of 49 feet during the fourth week of April. Three days later the river had reached 42.8 feet, but the outlook was steady at 49 feet

possible from April 19th until the 22nd. The next day, on April 14th the crest was forecast for 50 feet making headlines in the Grand Forks Herald as the Flood of the Century.

The Corps of Engineers is authorized to raise dike levels only three feet higher than the NWS forecast (Loss, USACE). A process of observation and modeling of past flood data generate the forecast. As the water continued to get higher and faster, the forecasters began projecting the data into the hypothetical extension of the standard rating curves. New forecasts seemed to stay only hours ahead of the actual river levels, and by the time that the 50-foot flood stage had been reached, it was clear that the water would continue to rise.

As the river rose to 50 feet and more over the next three days, one more airborne survey was flown over the Red River of the North. USGS measurements indicated that ice was causing a shift of 1.4 feet above the rating curves used to make the river predictions. On April 16th the USACE was advised to raise the city levees to 54 feet. On the 18th the river reached 52.6 feet and the crest was predicted for 53 feet the following day.

By the early morning hours of April 18th the evacuations had begun. Lincoln Park residents were awakened by the National Guard and rushed from their homes as the Red River came pouring through the dikes that had protected them for twenty years. Riverside area homeowners were the next to face the mandatory evacuation and by the end of the day Friday, it was clear that the city would lose the Flood Fight of 97. On Saturday, the remaining sections of the city were called to evacuate the area.

On Saturday, April 20th, fire started downtown in the afternoon. With three feet of water in the streets, fire department trucks were swamped before they could reach the scene. The trucks were loaded onto Army flat beds and carried into the downtown area where firefighters had to connect the hoses to fire hydrants under the surface of freezing and contaminated floodwater. Later that night the city water system was compromised causing a

complete loss of pressure. Sunday morning, after the National Guard completed the evacuations from the downtown apartments, fire retardant chemicals were dropped on the burning buildings by air tankers and sky crane helicopters were used to drop flood water onto the fires.

On April 21st and 22nd the Red River crested in Grand Forks at an estimated level of 54.1 feet (NWS, 1997). The slow fall of the river level gradually exposed the tops of the levees and eventually added up to eleven days above the original 49 foot crest prediction. While no deaths are attributed to the flood, initial damage estimates place the losses at $4 billion dollars in the immediate vicinity of Grand Forks and East Grand Forks.

Catastrophic Damage

The damage caused by these compound factors was comprehensive. City offices, county offices, emergency services and facilities, transportation, utilities, private businesses, community organizations, schools, churches, charities, and private residences were shut down and abandoned for the duration of the emergency. Only the telephone company and the news media maintained service throughout the disaster.

Government officials maintained their operations out of the Emergency Operations Center (EOC). Originally located in the basement of the Police Department, the EOC moved to the University of North Dakota (UND) campus and finally into the broadcast facility in Ryan Hall-Rural Technology Center. City evacuation shelters were moved from the Civic Auditorium to Red River High School and finally to the Grand Forks Air Base.

The University of North Dakota had seventy-two flood damaged buildings including the School of Medicine and the Energy and Environmental Research Center. The sixty-nine miles of underground steam pipes, service tunnels and utility lines were extensively damaged. Early estimates of damage at UND included $3.7 million for emergency response,

$22.8 million for permanent repairs and $8.5 million in lost research and contracts. Eighteen months later, the estimate of damages had risen to $75 million as time and effort revealed more extensive damage than could be determined (Orvik, 1998).

Response

The federal response to the flood of 1997 began with the first NWS forecast of severe flooding for spring snowmelt. The early numerical assessment allowed for Corps construction of emergency dikes well in advance of the predicted river crest. Equipment and materials were staged in critical locations to minimize the reaction time during the flood crest. The State of North Dakota, specifically the Governor's office, coordinated the efforts of many agencies and called out the National Guard to facilitate the flood fight, assist with evacuations, and maintain security in the flood zone. Appendix H is a summary of the state government offices that provided assistance to the City of Grand Forks during the Flood of 1997. Volunteer organizations provided food for the sandbaggers and the troops, as well as coordinating the availability and distributing the manpower as the flood fight reached its final days.

Recovery

The recovery process began even before the damage assessment could begin. FEMA reservists registered residents for relief assistance. Information was distributed to all the evacuation centers, by the news media, and in all the surrounding communities where evacuees had found refuge. Television advertising urged residents to register with FEMA to receive the assistance to which they were entitled. While floodwater prevented the return of residents to their homes for almost two weeks, the FEMA assistance appointments began immediately in shelters and in nearby towns.

For homeowners, the first thing to be done was to pump the remaining floodwater out of the basement, then haul the debris out to the berm. For the city the most critical need was running water. Without water or power, even the volunteer cleanup crews could not stay over night. Residents found themselves driving in to work all day without water, power, heat, or light and returning to shelters covered with flood mud. In addition, contractors for electricity and heating were unavailable, the appliances needed were quickly out-of-stock, and insurance investigators were overbooked and overworked.

In neighborhoods near the river the fate of the homes was determined by the ratio of damage to value. Historic neighborhoods suffered some of the worst damage near the river, and thousands of homes outside the flood plain incurred major damage as well. Ten percent of homes in Grand Forks were damaged beyond repair. For these residents FEMA set up mobile home parks as a temporary measure. The City initiated a voluntary buyout program for homeowners with property damaged beyond 50% inside the 100-year flood plain. Eventually this program expanded to four phases of acquisition and has cost more than $51million (Dean, 1998).

Businesses in Grand Forks were faced with the loss of their facilities, employees, and customers, but not their overhead. FEMA worked through the Small Business Administration and other partners, listed in Appendix I, to process loans for recovery. Today, in the city, the physical damage may be removed from sight, but the impact shows up on the balance sheet of local businesses and savings accounts of homeowners.

The city also had to find a way to support the institutions that hold the social fabric of a community together. Schools were dismissed during the flood fight, medical facilities had been evacuated, churches were physically damaged, congregations were scattered, news

reporters were camping out at their stations, and emergency personnel had been on duty throughout the flood.

Just at the moment when every single person, in Grand Forks is in need of assistance from one program or another and even the programs are in need of assistance to provide the services that they offer, the community must begin to consider the measures necessary to prevent another flood. This political window of opportunity is open only for as long as outrage is not replaced by blame. The Corps began immediately to reevaluate the flood control measures needed to protect the cities of Grand Forks and East Grand Forks. That document was completed in only eighteen months, rather than the normal 48 months, so that the cities could begin immediately with physical structural improvements to prevent another flood disaster of the same magnitude.

The 1999 General ReEvaluation Report Flood control proposal is estimated to cost $350 million dollars. It contains the engineering plans for a variety of floodwalls, dikes, and channel improvements as well as the required Environmental Impact Statement for the project. The City of Grand Forks received one copy.

The addition of the Flood of 1997 to the historic record of flooding in Grand Forks will result in a new line of demarcation for the 100-year flood plain. This will place more structures in the flood plain and require more homeowners to participate in the subsidized insurance program.

The data in the following chapter indicates the financial impact of flood damage on the city. The damage value data is the difference between the appraised value of the property before the flood and the appraised value of the property after the flood. Although estimates on total damages escalated as repairs began, the actual figures are not available at this time.

CHAPTER V

DISCUSSION OF DATA

The City of Grand Forks damage statistics from the Tax Assessor's Office show the effect of the Flood of 1997 on the city tax base. They do not reflect the damage to property that is tax exempt such as schools, churches, and state or federal property. While this is very important to the future of city funding, the fact that not all damage is tracked by the assessor's office makes the total damage figures incomplete. This also skews the percentage of damage in each category of land use.

City property is given an individual identification number, a land use category, and an assessment of damage caused by the Flood of 1997. There were areas in Grand Forks with no flood damage. However, using this data it is impossible to distinguish those with no damage from those with no data. Table 3 shows the land use category, the total damages for those properties and the number of properties in each category.

The legend for the land use codes was determined by the first digit of the code that was assigned by the city. The legend for the damage value was determined by an assessment of natural breaks in the damage figures. Due to the presence of 8500 residential properties in the tax base it seemed appropriate to create categories that reflected the various degrees of damage with in that large category. The legend groups all damage from $51,000 to almost $1 million in only one category. That large range of damage includes only a small number of properties.

The data is formatted into a summary table that shows the dollar value of damage assessed in each category of land use. The table information is represented in pie charts that show the percentage of damage in various categories. Finally, two ArcView maps are included with this document that show the geographic distribution of land use and property damage in Grand Forks.

Table 3. The summary of flood damage data from the City Tax Assessor's Office.

LANDUSE	CATEGORY DAMAGE	NUMBER of PROPERTYS	GENERAL USE CATEGORY	SUB TOTAL
1	2214600	70		
111	84129700	8574		
112	890950	191		
114	4912800	901		
115	0	55		
120	706600	38		
121	3092300	268		
122	0	40		
124	635700	57		
131	16512400	450		
132	1550200	125		
135	0	16		
136	0	502		
138	0	124		
140	0	11		
150	0	11		
152	0	20		
160	481600	23		
170	1113400	107	100	116240200
211	0	135		
213	2600	54		
216	0	61		
217	0	11		
230	0	29	200	2600
310	22300	17		
311	685000	21		
350	305000	60	300	1012300
410	146100	33		
450	521700	31		
460	29900	16		
472	54000	34	400	751700
510	1727800	133		
511	3398850	65		

521	702800	55		
542	251500	70		
545	270800	44		
551	1824400	32		
552	624275	65		
555	213300	21		
558	543800	15		
560	0	65		
561	0	2	500	10079800
610	4550800	111		
619	524100	22		
639	986800	59		
662	418600	30	600	6480300
730	0	17		
734	0	29		
741	0	65		
743	0	3		
744	0	3		
745	0	16		
746	27500	7		
754	61300	61		
757	0	10		
760	85800	14	700	174600
812	0	91		
849	233700	10		
850	0	78		
851	22565300	464		
852	1073900	25		
853	936100	18		
854	183900	9	800	24992900
991	4200	284		
992	0	46		
993	0	21		
996	337200	40		
998	341200	19		
999	23100	430	900	705700
TOTALS	160440175	14634		160440175

The land use codes assigned to each property are further explained in Appendix A. For example, a general category such as Residential (100) is further subdivided into single family with yards (111), townhomes (114), duplexes (121), apartment buildings (131), condominiums (138), and others. A series of pie charts in Appendix A illustrates the

proportion of damage within each category, but the overall picture can be misleading without careful interpretation.

Data Analysis

A summary of flood damage from Table 3 using the two columns on the far right (general category and damage subtotals) is shown in Appendix B. The chart illustrates the overwhelming impact of the Flood of 1997 on residential property in Grand Forks. The percentages in this chart can be interpreted as the percentage of loss to the remaining tax base. It is not the percentage of total flood damage in the City of Grand Forks because several sub categories are tax exempt and therefore not part of the subtotals for general land use.

The data files provided for this study by the City of Grand Forks list the amount of damage for all the property in the tax base. Of the more than 14,000 records in that file, there are 8574 residential properties. This largest category is represented in Figure 1 where 73.78% of the residential damage is to single family homes (111) and the only other code with more than 10% damage is apartment buildings (131). Although these proportions should accurately represent damage within the category, it is only part of the flood damage. There are several codes that are tax exempt in this group and no data is available: townhouse commons (115), condo duplex (122), condo land and units (135, 136, 138), mobile home (140), university housing (150), fraternity and sorority housing (152), Also, property that was bought out by the city has been reclassified as open space (800).

In the open space category 98% of the damage is in three land use categories designated as lost housing (851, 852, 853) shown in Figure 1. The value of those lost homes from Table 3 equals $24,575,300. When this number is added to the total damage to

residential property the new figure is $140,816,000. Oddly, the property assigned as park (812) and open space (850) are, in fact, tax-exempt and there is no data for them.

Two other categories of land use are largely tax exempt and no chart can be made for them. They are the 700s that include schools, churches, and government buildings, and the 200s which is described as mostly right of way, where only one property is listed as having $2600 damage. In Grand Forks, the school district is a separate institution from the city and the same is true of the park district. Therefore, the financial statements that contain damage figures for these institutions are not kept on file by the city.

The damages to retail businesses (500s) from Table 3 total more than $9.5 million. The percent of damage in each specific sub category is shown in Figure 1, with the exception of commercial condos (560,561) where sixty-seven properties have no damage listed. These 500 businesses include gas stations, hotels, stores, bars, and restaurants.

The damage to industrial (300), transportation (400), and professional (600) facilities is shown by figures 1, 1, and 1 in Appendix B. In each category the largest damages were in one sub-category. The land use category (900) is vacant land at the time of the flood. It represents 733 properties with $705,700 damage.

Map Analysis

The same land use data and property damage values were used to create two maps of Grand Forks. The scale of these prints is 1:15000 to facilitate the visual assessment of individual property. These maps are composed of property boundary shape files but do not contain street layers. Only a few named features have been included to help speed orientation and avoid clutter. The Lambert conic projection seemed to be the most familiar format and was selected for that reason only.

The land use codes map clearly shows the predominance of residential neighborhoods near the river in Grand Forks. The older parts of town have smaller lots where the street grid parallels the river while newer sections have larger lots, fewer square blocks and collector streets that line up with survey section lines (North/South).

Damage, however, did not follow growth. The damage was a result of proximity to the river, and the property value at the time of the flood. Old homes in historic districts were damaged, but new homes on the south end were damaged too. Commercial buildings and apartments suffered higher damage because they have higher real estate value than individual private residences.

The Damage map lists categories based on reasonable breaks. These categories reflect the large number of residential properties in the data base with only 489 properties in the maximum damage category.

Table 4. Number of properties per damage category.

Number of properties	Damage Estimate
5572	No Data/No Damage
1733	100-5400
1724	5500-8100
1577	10900-10800
1478	14500-14500
1327	21800-21700
1111	21800-50800
489	51000-865500

The conclusions that can be drawn from this case study are presented in the next chapter. By considering the history of flood control, the dichotomy of political jurisdiction, and the forces of nature, it is possible to gain a wider perspective on the pace of change in Grand Forks and the Red River Valley.

CHAPTER VI

CONCLUSIONS

The process of flood plain management is a complicated application of federal policy through local government participation that requires interactive planning, constant communication, and an accurate perception of the risk involved. The history of encroachment on the nation's flood plains has created a legacy of disaster as well as a window on the learning curve of mitigation. Each flood teaches us something about what works and what will not. The last two hundred years has taught us that we are still learning.

The need for a comprehensive nationwide approach to flood plain management is complicated by the geographically unique characteristics of each community at risk. The Red River of the North flows north along a shallow gradient. The headwaters thaw while the remainder of the basin is still ice-packed. Agricultural land consists of bare soils in frozen fields, while elevated roads and deep drainage ditches aggravate overland flooding in the spring. Urban expansion of Grand Forks is southward, along the river, and growth puts additional pressure on the movement of water through the valley. City politics is growth oriented, and city leaders are expected to facilitate growth.

These same leaders are expected to protect their growing city from natural disasters, such as floods, that are influenced by changes in land use caused by growth. Since politicians are not elected based on their emergency management skills, they have to depend on larger agencies to provide the information needed for making local decisions. Only ten years ago the major water issue in eastern North Dakota was the Garrison Diversion, which was

supposed to bring water into the region from the west. At the end of the millennium, the focus is on keeping the river from wiping out the cities of the Red River Valley.

The Flood Fight in 1997 was a well-run operation. The NWS created a numerical outlook early so that the Corps could contract for emergency operations on the city levees. The state requested and received a Presidential declaration in advance to ensure that federal funds would be available for the flood response. The City was confident that a 49-foot flood was well within their ability to control. The 1979 flood had taught them a thing or two about being prepared. Their vast experience with spring floods was their fatal flaw.

Everything that should have told the city planners that they were in big trouble had happened before in Grand Forks. They had levees in place, extra pumps for the lift stations, million of sandbags on hand, and dedicated volunteers. Like the Titanic they sailed into the ice field with confidence built on years of experience. What happened on April 18th was completely unexpected. Most dikes that had protected the city for twenty years failed. The damage from the ice storm that slowed the fight proved devastating to the projections of flow rate and river crests.

The Red River became the river of denial as residents had difficulty believing what they saw happening. The war zone analogy was pervasive. Flood victims were refugees in surrounding communities. Emergency Operations took the place of city government. Logistics and support issues included potable water, contaminated homes, communications, power, and security in the evacuation zones. They fought the flood and the flood won. The state cartographer created the map in Appendix C by digitizing aerial photos and it shows the area inundated by the Flood of 1997.

The NWS performance during the months prior to the flood generated considerable controversy when their methodology was questioned in the local news media (GFH, 1997).

The rumored existance of a more accurate rating curve for the Red River seemed to place the blame for the disaster on the flood forecasters, but the truth is that at the time of the disaster no one could have known which of the models would turn out to be closer to the actual observed levels in Grand Forks (NWS, 98).

The Mayor became the focal point for the media and the residents during the crisis, but the recovery became mired in politics at every level. Outraged residents expected quick answers to complex issues. Rage motivated the city to hire additional security for City Hall, as controversy became part of the process.

Controversial exemptions for historic districts that have a place in the identity of a city not easily filled by new developments, fueled the heated debates. They are protected by federal laws and they have some exemptions from FEMA regulations. An early proposal to register the Sorlie Bridge as a historic structure was abandoned when it became clear that future improvements to the bridge would be prohibited in the name of preservation. The downtown footbridge is currently controversial. The Corps plan refers to its removal as the first contract to bid. The bridge, however, is the very first one to connect Grand Forks to Minnesota. Its design is unusual and it has survived since it was built, but the Corps sees it as an unnecessary obstacle (GRR, 1999).

When fire destroys a historic building, that loss is tragic, but unavoidable. When politics take away our history, that is our own fault. The Historic Preservation Commission in Grand Forks has been vocal in their defense of the downtown buildings that survive.

Politics is not just about funding, but funding is where it gets serious. The controversy over construction projects should be explored in greater detail but some mention of them is required.

Washington Street, where a secondary dike prevented the mandatory evacuation of the last section of Grand Forks, was lowered to grade level with previously acquired federal funding immediately after the flood in order to make the intersections safer during the winter for traffic. The controversial $50 million Aurora project, which had been narrowly approved prior to the flood, cost nearly the same amount that the city requested from the North Dakota legislature to pay for the proposed Corps dikes.

Those proposed dike lines will protect the city, but they will cost more than money. Several homeowners whose property was not destroyed by the flood are simply in the way of the best-fit line. These property owners are reasonably doubtful that this is absolutely necessary. Three areas of protection for the city of Grand Forks remain in undetermined status. Some property owners feel that they should have the right to have their home on the wet side of the dike, but that may endanger the rest of the city. Property rights extend as far as the public safety allows. We all live downstream.

The history of floods and flood response has demonstrated the pattern of critical timing in disaster recovery. Unfortunately, the window for meaningful political action is not large enough to allow for all the necessary research to arrive at the appropriate conclusions. Often, any action is perceived as better than waiting for an indefinite period. Hence the prevalence of the structural solution. The known costs and benefits of these projects make people very comfortable spending tax money for their construction.

The Corps proposal for Grand Forks and East Grand Forks is estimated to cost $350 million, and it is only designed to protect the two cities at the Forks. The project does not address the larger issues of the Red River Basin, but it does include an Environmental Impact Statement for the proposed construction as required by law.

The International Joint Commission directed task force members to examine a range of alternatives to prevent and reduce future flood damages in the Red River Basin. That report contained 40 recommendations to improve everything from river gages to ring dikes for towns from Lake Traverse to Winnipeg.

Environmental issues are no less complex than the political environment that governs flood plain management. While it widely accepted that the physical ecosystem of a flood plain may be more complex than we understand, yet it is also possible that the web of multi-level participation by government agencies in flood plain management is also more complex than it is possible to understand.

Floods can be expected to continue on the Red River of the North. The presence of cities in the flood plain will continue to expose people and property to the risk of disaster.

APPENDICES

APPENDIX A

LANDUSE CODES FOR THE CITY OF GRAND FORKS

Documentation for
LUCODE.DBF

This file is a lookup table to land use codes and their meanings.

LUCODE Number 3.0 Planning
This is a three-digit land use code found in PROP.DBF in the field named LANDUSE.

LAND-USE Text 30 Planning
The meaning of land use codes.

001 - Special Parcel without Land
These are properties with numbers starting at 4000.001.00 and over. The land for these properties is accounted for in other properties.

111 - Single Family
Single family detached houses with yards on all sides. These are almost always one house per property, but occasionally there are two.

112 - Single Family Attached
Single family attached houses usually have one common wall on the property line and one side yard. In a few cases there are more than two units attached, side by side, with all common walls on a property line.

114 - Townhouse
Townhouses are clustered in two or more units with common walls. Each unit is on its own lot. Typically the property line is one foot from the outer wall or at the common wall.

115 - Townhouse Common Land
The land around townhouses owned by the townhouse association.

120 - Undetermined Multiple Residence
Properties with more than one housing unit where type is not known.

121 - Duplex
Two attached housing units on one property. Very few have been built in recent years.

122 - Condo Duplex
Two attached housing units where the units are individually owned, with each owner having an undivided interest in the land. These are rapidly being replatted into single family attached.

124 - House with Basement Apartment
Basement apartments have always been difficult to track. The owners of many houses which had basement apartments choose not to rent them. The flood damaged most basement apartments and few owners are repairing them so that they can be rented again.

131 - Apartments
These are structures built as multiple family dwellings, but does not include UND housing.

132 - Converted Single Family
These are older large houses converted to apartments.

135 - Condo Land
Properties that include the land and building shell, but no units.

136 - Condo Unit/Garage
Residential condo unit or garage where the land and building shell have a separate property number.

138 - Condo Unit with Land
Residential condo unit where an equal share of the undivided interest in the land and building is included with the unit.

140 - Mobile Home
Mobile park land and permanent buildings.

150 - Dormitory/University Housing
Dormitories are group quarters and not counted as housing units, but any units with private kittens and bathrooms are considered housing units.

152 - Fraternity/Sorority
These are group quarters.

160 - Group Home/Nursing Home
More group quarters.

170 - Home Occupation
Single family houses from which a business is operated.

211 - Public Right-of-Way
Most public right-of-way is obtained through dedication, but the City and State have deeds to a few properties that were purchased for street widening, etc.

213 - Parking Lot
These are primarily public parking lots or structures. This accounts for a very small part of parking-since most land devoted to parking is a part of the same property which has the structures. When structures and associated parking are on different properties, the land use code assigned to the land have the structure is used for the land used for parking as well.

216 - Railroad Right-of-Way

217 - Airport

230 - Water/Sewer System
Water treatment plant, water towers, lift stations, etc.

31 0 - Manufacturing
Manufacturing, except food and agricultural processing.

311 -Food and Agricultural Processing

350 - Construction Trade

410 - Warehousing/Moving/Storage

450 - Wholesaling

460 - Freight Distribution/Transport

472 - Fuel and Power

510 - Retail

511 - Mixed Commercial-Residential
Commercial buildings with upstairs apartments.

521 - Shopping Mall

542 - Auto Dealer/Repair/Body Shop

545 - Gas Station/Convenience Store

551 - Hotel/Motel

552 - Restaurant

555 - Drinking Establishment/Liquor Store

558 - Grocery/Specialty Food Store

560 - Commercial Condo Unit

561 - Commercial Condo Commons

610 - Offices

619 - Banking

639 - Service/Entertainment Business

662 – Medical/Dental/Optical Care

731 - Federal/State Government

734 - Local/County Government

741 - University

743 - High School

744 - Middle /Junior High School

745 - Elementary School

746 - Day Care/Misc. School

754 - Church/Religious Organization

757 - Cemetery

760 - Non-Profit/Civic/Social Organization

812 - Park/Playground

849 - Indoor Recreation

850 - Open Space
Land which is not a part of a park, but development will not be permitted. Most of this is along the river.

851 - Lost Single Family
Land which was single family before being lost to the flood or dike.

852 - Lost Single Family
Land which was used for duplex or townhouse before being lost to the flood or dike.

853 - Lost Multiple Family
Land which was multiple family before being lost to the flood or dike.

854 - Lost Commercial
Land which was commercial before being lost to the flood or dike.

855 - Lost Public Building
Land which was used for a public building such as a school before being lost to the flood or dike.

991 - Vacant Lot (Single Family)
Platted lots zoned for single family before a building permit is issued. The lot may have already been purchased by someone intending to build their future home.

992 - Vacant Lot (Multi-Family)
Platted lots in a PUD designated for multiple family development, but with no building permit yet issued.

993 - Vacant Lot (Townhouse)
Lots platted for townhouse development, but with no building permit issued.

996 - Undetermined Commercial/Industrial

998 - Vacant Building

999 – Vacant/Undeveloped Land
Presumably this land could be developed.

APPENDIX B

TAX ASSESSOR DATA CHARTS

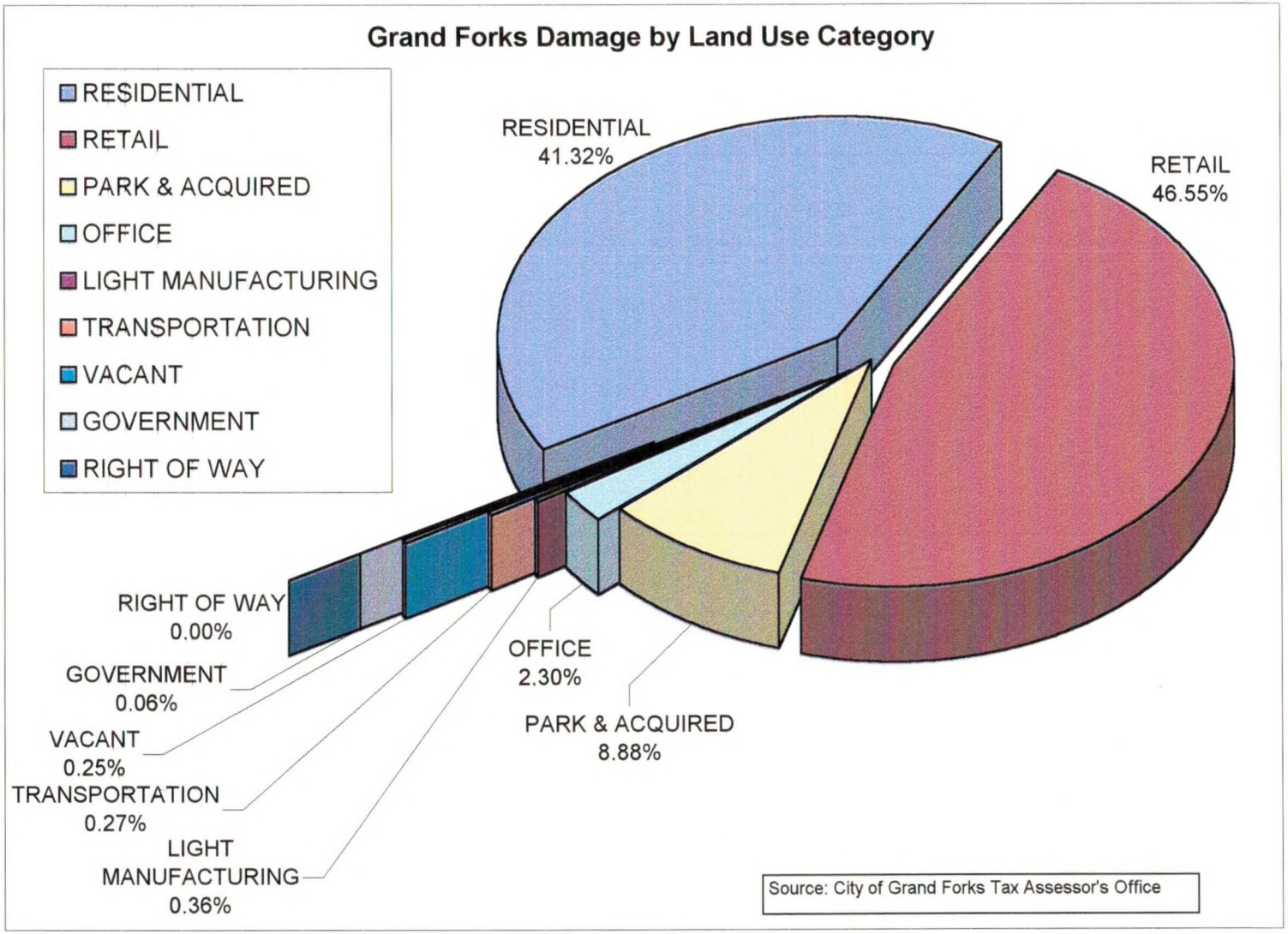


Figure 1. Damage By Land Use Category.

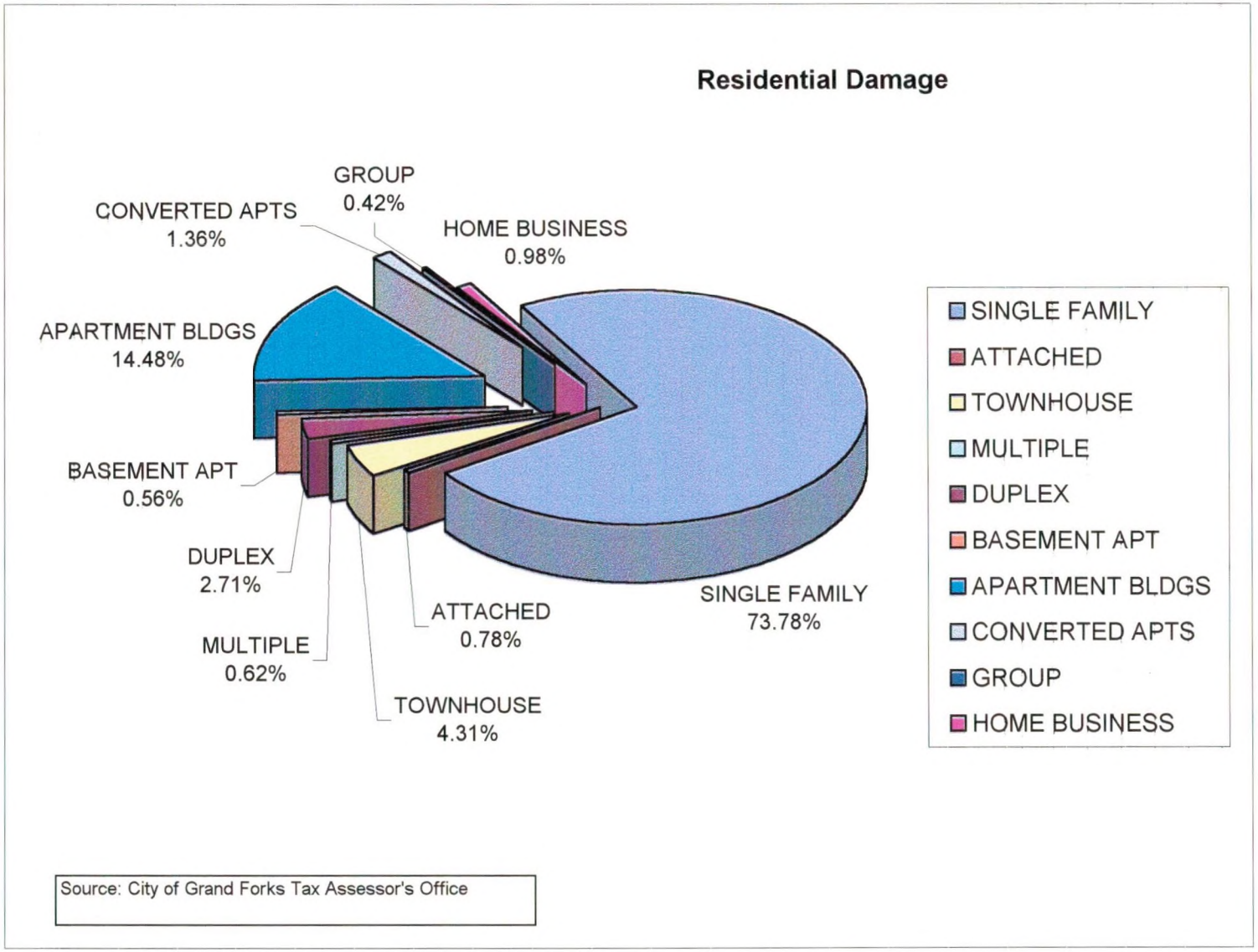


Figure 2. Residential Damage

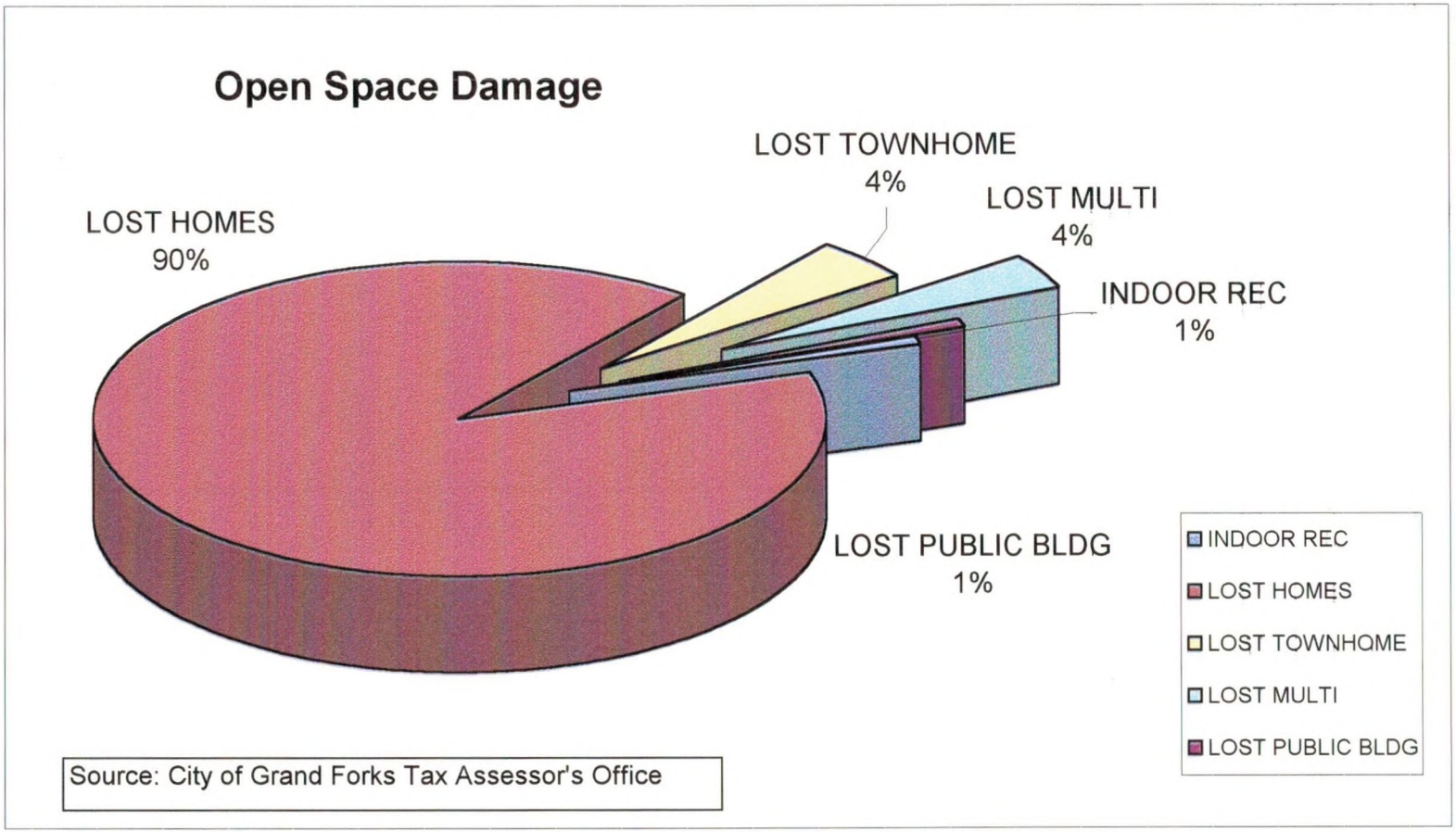


Figure 3. Open Space Damage

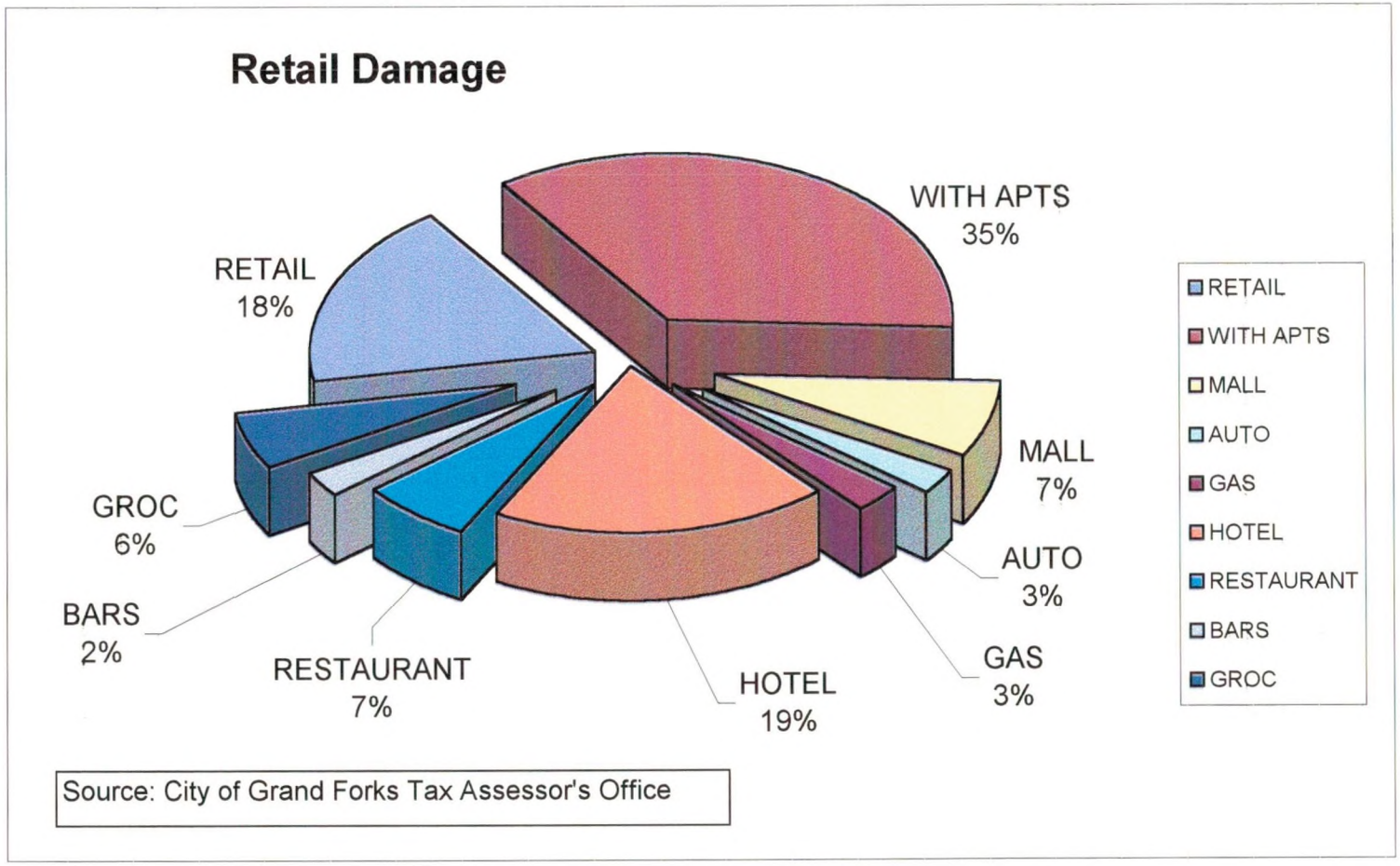


Figure 4. Retail Damage

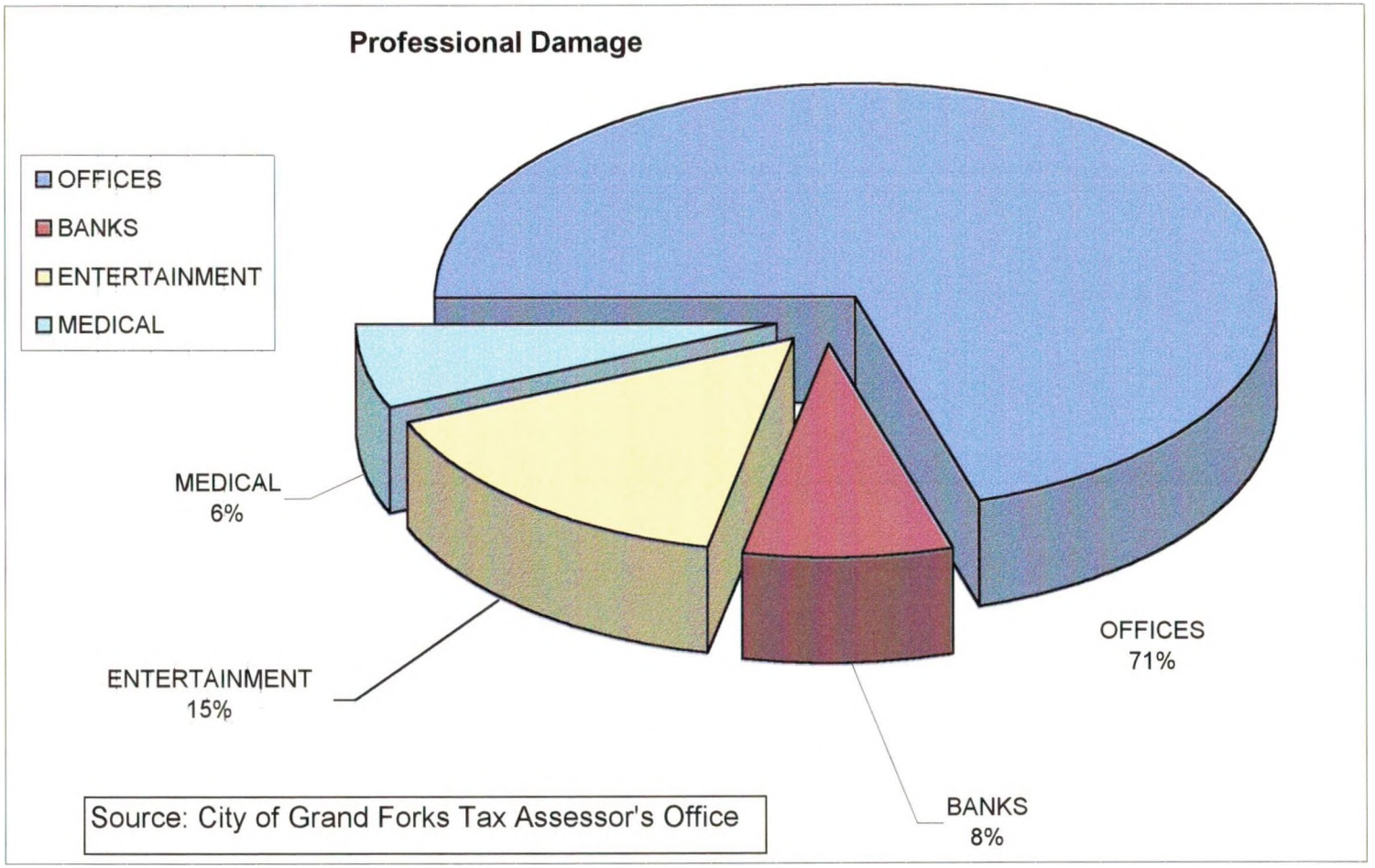


Figure 5. Professional Damage

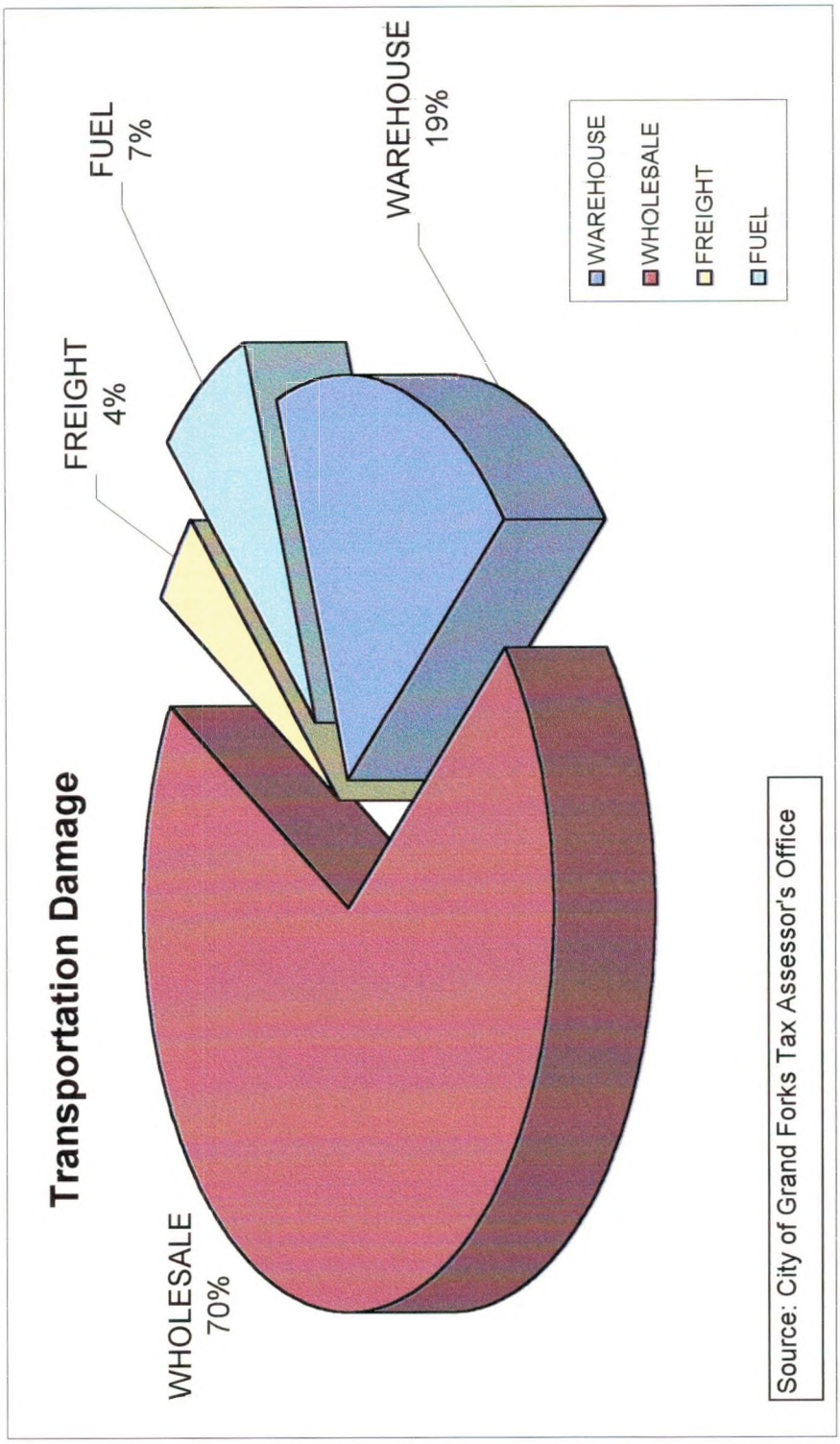


Figure 6. Transportation Damage

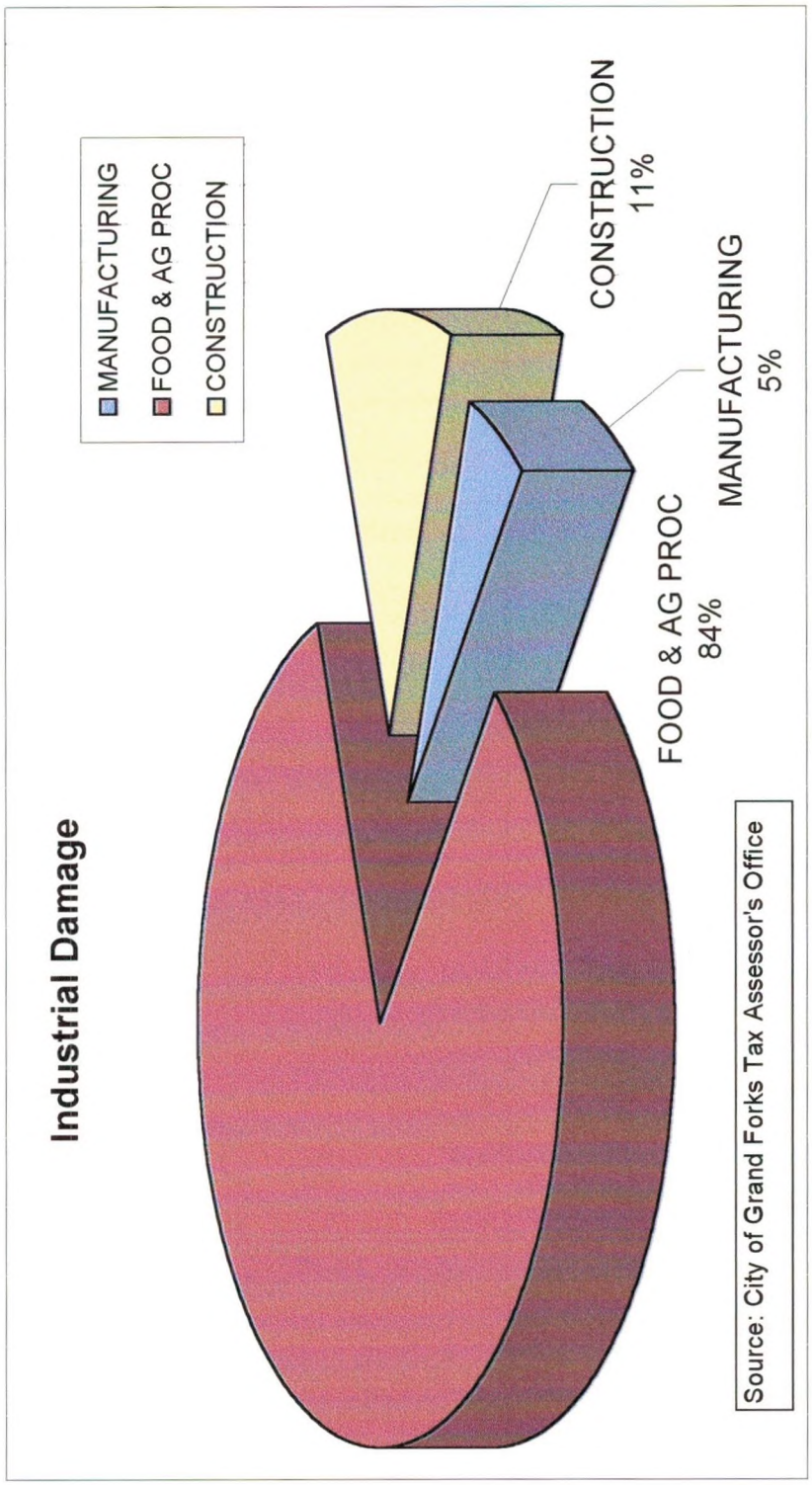
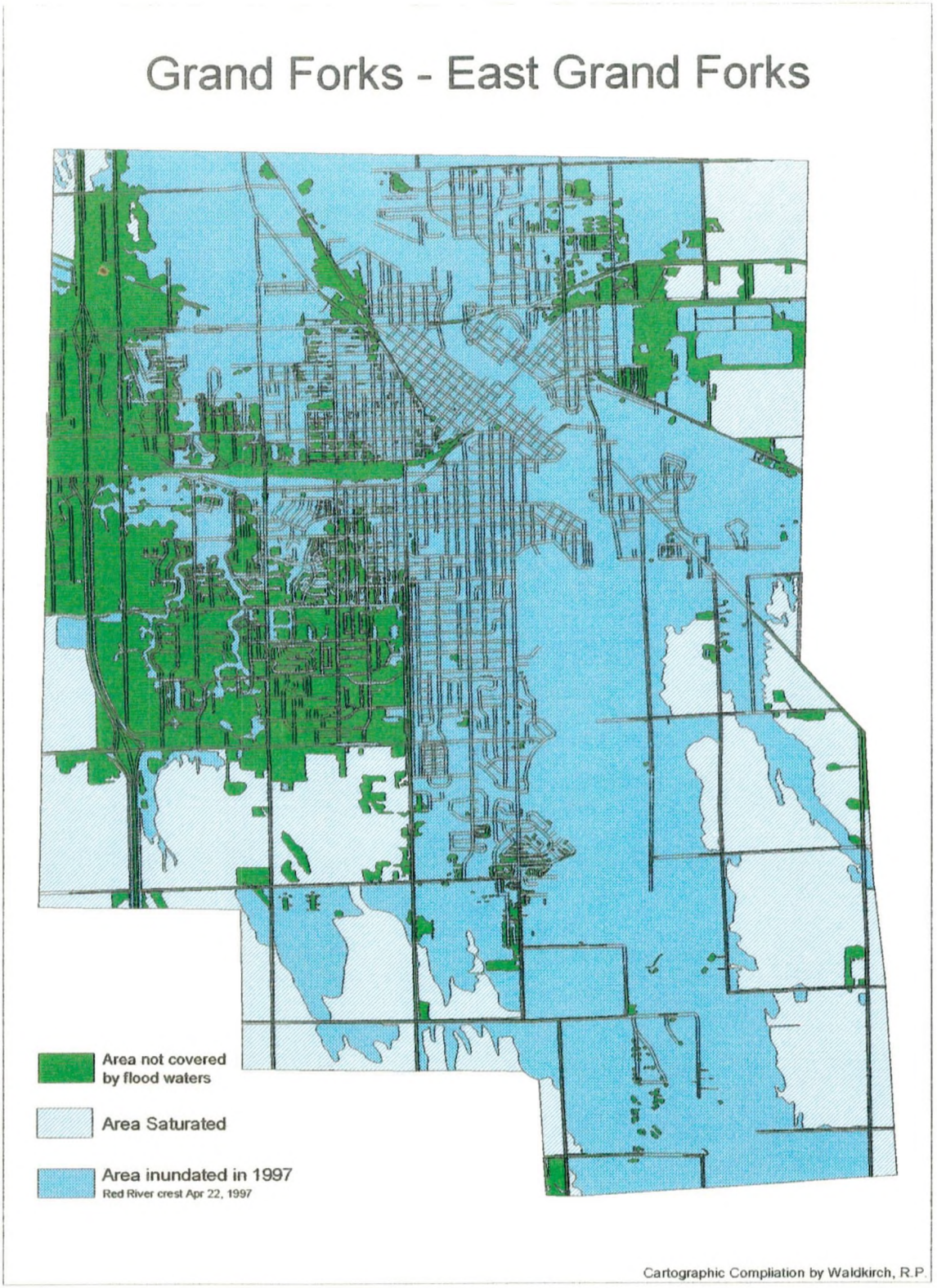


Figure 7. Industrial Damage

APPENDIX C



STATE CARTOGRAPHER'S FLOOD MAP

APPENDIX D

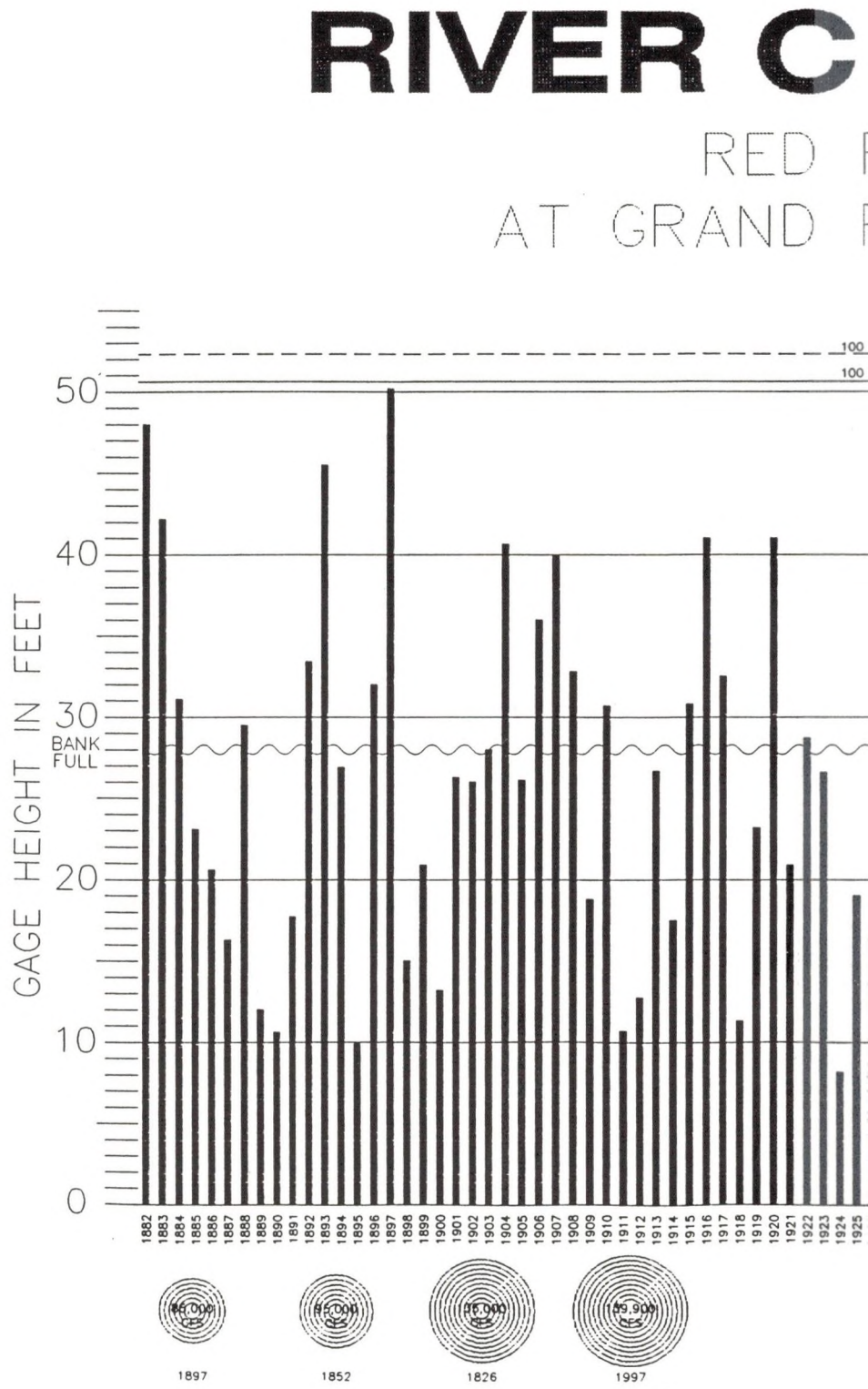
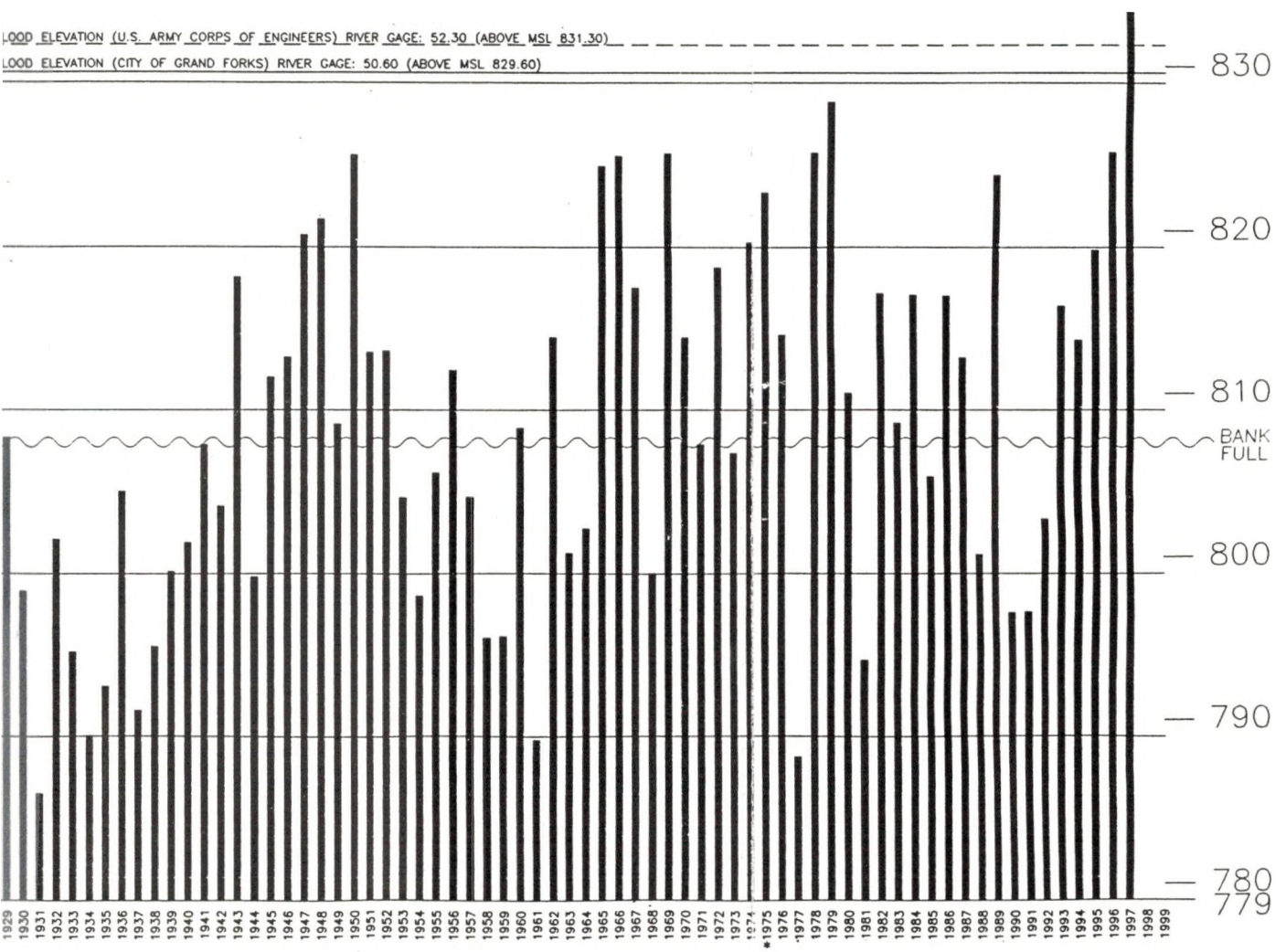


Figure 8. City Floods of Record Bar Graph

RESTS BY YEAR

VER OF THE NORTH
ORKS–EAST GRAND FORKS



Source: Grand Forks Information Center, 1998.

APPENDIX E

NATIONAL WEATHER SERVICE CHRONOLOGY

http://tgsv5.nws.noaa.gov/oh/Dis-Svy/RedR-Api97/Append-A.htm

Date(s)	Time	Comments (local)
2/6 - 9/97		Airborne snow survey of the Red River of the North conducted.
2/13/97		First Snowmelt Outlook issued using data from the airborne snow survey. The potential for spring flooding was characterized as "Severe" defined as levels at or exceeding the previous flood of record.
2/19 - 23/97		Airborne snow survey of the Red River of the North conducted.
2/20/97		USACE requested internal numerical flood crests. Decision to issue second Snowmelt Outlook in a numerical rather than categorical fashion was made and coordinated by the NWS.
2/24/97		Emergency managers notified that updated Snowmelt Outlook on 2/27/97 would be numerical.
2/27/97		Snowmelt Outlook updated. Outlook called for 47.5 feet with no additional precipitation and 49.0 feet with normal additional precipitation. The 49.0-foot forecast exceeded the existing flood of record that occurred on 4/26/79 (48.8 feet). Record numerical peak forecasts allowed the USACE to initiate advanced flood protection measures earlier than would otherwise have been possible.
3/6 - 12/97		Airborne snow survey of the Red River of the North conducted,
3/13/97		Snowmelt Outlook updated. No change from guidance issued on 2/27/97-
3/18 - 21/97		Airborne snow survey of the Red River of the North conducted.
3/23 - 27/97		Airborne snow survey of the Red River of the North conducted.
3/27/97		Snowmelt Outlook updated. No change from guidance issued on 3/13/97.
3/30/97		Flood Warning issued for all NWS river forecast points in the Red River of the North Basin.
4/3/97	1220	Current stage 18.1 feet. Forecast to continue to rise. Outlook with normal pcpn 49.0 feet. (Note that river model indicates that forecast peak may be well below the outlook peak of 49.0 feet, but forecasters were reluctant to lower the guidance.)
4/4/97	1230	Current stage 23.6 feet. Forecast to rise to FS by 4/5. Outlook crest with normal pcpn 49.0 feet.
4/5 - 6/97		Severe blizzard conditions throughout Red River of the North. One to three inches of precipitation falls. Cold, windy, and snowy conditions hampered data collection and flood-fight activities.
4/5/97	*1500*	Current stage 28.4 feet. Outlook crest with normal pcpn 49.0 feet.
4/6/97	1330	Current stage estimated at 35.7 feet. Outlook crest 49.0 feet. (Note that since above normal precipitation had already occurred, the condition for the outlook crest was dropped.)
4/7/97	1400	Current stage 36.5 feet. Outlook crest 49.0 feet in mid- to late April.
4/8/97	1630	Current stage 38.8 feet. Outlook crest 49.0 feet in mid- to late April.
4/9/97	1210	Current stage 41.5 feet. Outlook crest 49.0 feet in mid- to late April.
4/9 - 12/97		Airborne snow survey of the Red River of the North conducted.
4/10/97	1300	Current stage-41.6 feet. Outlook crest 49.0 feet in mid- to late April
4/11/97	1230	Current stage 42.0 feet. Outlook crest 49.0 feet beginning 4th week of April.
4/12/97	1130	Current stage 42.3 feet. Outlook crest 49.0 feet beginning 4th week of April. (USGS measurements of flow indicate that ice effects are causing a 3.55-foot shift above the current rating curve). (Airborne snow survey completed.)

4/13/97	1110	Current stage 42.8 feet. Outlook crest 49.0 feet. This crest will be very broad, occurring as early as April 19, and extending as late as April 21-22. (Updated estimates of areal snow water equivalent delivered to the NCRFC for use in runoff model.)
4/14/97	1630	Current stage 43.7 feet. Crest 50.0 feet - April 19-22. (Note this is the first non-outlook crest forecast for East Grand Forks).
4/14 - 17/97		Airborne snow survey of the Red River of the North conducted.
4/15/97	1330	Current stage 45.3 feet. Crest 50.0 feet - April 22-23.
4/15/97	2134	Current stage 46.4 feet. Crest 50.0 feet - April 22-23. (USGS measurements of flow indicate ice effects are causing a 1.44-foot shift above the current rating curve).
4/16/97	0950	Current stage 47.5 feet. Rise to 49.0 to 49.5 feet - April 17, then slow rise to 50.0 feet April 22-23. (USACE field construction personnel alerted to raise emergency flood protection by raising top of the levee to a stage of 54.0 feet.)
4/16/97	1620	1600 stage 48.4 feet. Rise to 49.5 feet by early April 17, then continue rise to crest of 50.0 to 50.5 feet - April 20-22.
4/16/97	2120	Current stage 48.8 feet. Rise to near 49.5 feet early on April 17, then continue rise to crest of 50.0 to 50.5 feet - April 20-22. (USGS measurements of flow indicate a 0.94-foot shift above the current rating curve).
4/17/97	1215	Current stage 49.6 feet. Crest 50.0 to 50.5 feet April 18 p.m. - April 19 a.m. (USACE contracts for additional resources to raise levees).
4/17/97	2125	Current stage 50.9 feet. Crest 51.5 - 52.0 feet - April 18; April 19. Ice effects in the area appear to be causing fluctuations in the rate of rise.
4/18/97	0905	Current stage 52.0 feet. Crest 53.0 ft April 18-19. (Severe seepage and boils behind levees in Belmont Park, Lincoln Park, and Central Park areas of Grand Forks with similar problems in East Grand Forks.) (Severe seepage and boils behind levees in Belmont Park, Lincoln Park, and Central Park areas of Grand Forks with similar problems in East Grand Forks.) (Sandbag levee on the Point in East Grand Forks breached allowing inundation of the Point area, following failure of efforts to shore up the levee.) (Numerous levee failures occurred on both sides of the river. USACE reported that all levee breeches and over-toppings appear to have occurred between river stages of 51.6 and 53.0 feet.)
4/18/97	1950	1900 stage 52.6 feet. Crest near 54.0 feet late Saturday (April 19).
4/19/97	0945	0500 stage 52.9 feet. Little change next few days - additional rises of 0.2 to 0.3 foot are possible. (Fire broke out in Grand Forks and destroyed I I buildings).
4/19/97	*1510*	1200 stage 53.1 feet. Rise to near 54.0 feet over the next few days.
4/19/97	2010	1800 stage 53.3 feet. Slow rise to near 54.0 feet next few days.
4/20/97	1135	Current stage 53.7 feet. Crest 54.0 ft - April 21. Fluctuations of 0.1 to 0.3 feet are possible. (Hydrologic Service Area (HSA) responsibility transferred from NWSO FGF to NWSFO BIS)
4/20/97	2106	Current stage 53.9 feet. Crest 54.0 feet - 4/2 1. Fluctuations of 0. I to 0.3 ft are possible.
4/21/97	1235	Current stage 53.9 feet. Near crest; remain near this level for several days. Fluctuations of 0. I to 0.3 foot are possible.
4/21/97	2130	Estimated stage 54.0 feet. Near crest; remain near this level for several days.
4/22/97	1130	Estimated stage 54.0 feet. Cresting; little change next 24-48 hours.
4/22/97	2119	Current stage 53.8 feet. Cresting; little change next 24-48 hours.
4/23/97	1010	Current stage 53.6 feet. Continue very slow fall next several days.
4/23/97	2116	1600 stage 53.2 feet. Continue very slow fall next several days.
4/24/97	1000	Current stage 52.6 feet. Fall to 5 1.0 feet by late April 25. Fall to 50.0 feet by 4.27. 0.1 to 0.3 foot surges in stage are possible.

4/24/97	2118	Estimated stage 52.0 feet. Fall to 5 1.0 feet by late April 25. Fall to 50.0 feet by 4.27. - 0.1 to 0.3 foot surges in stage are possible.
4/25/97	1045	Stage missing. Slow fall.
4/25/97	2124	Current stage 50.5 feet. Continue slow fall.
4/26/97	0945	Current stage 49.7 feet. 3-day forecast: 48.0/46.8/45.9 feet
4/26/97	2124	Current stage 49.1 feet. 3-day forecast: 48.3/47.2/46.3 feet.
4/27/97	0935	Current stage 48.2 feet. 3-day forecast: 47.0/45.8/44.3 feet.
4/27/97	2142	Current stage 47.6 feet. 3-day forecast: 47.1/46.0/45.3 feet.
4/28/97	0935	Current stage 46.9 feet. 3-day forecast: 46.0/44.6/43.2 feet.
4/28/97	2118	Current stage 46.4 feet. 3-day forecast: 46.0/44.6/43.2 feet.
4/29/97	1045	Estimated stage 46.2 feet. 3-day forecast: 45.5/44.8/44.4 feet.
4/29/97	2119	Current stage 45.3 feet. 3-day forecast: 45.0/44.5/44.1 feet.
4/30/97	0915	Current stage 44.8 feet. 3-day forecast: 43.9/42.7/41.5 feet.
5/01/97	1005	Estimated stage 43.9 feet. 3-day forecast: 43.0/42.1/41.2 feet.
5/02/97	1025	Current stage 43.8 feet. 3-day forecast: 43.0/42.2/41.4 feet. Continued slow fall

APPENDIX F

AREA MAPS

RED RIVER VALLEY

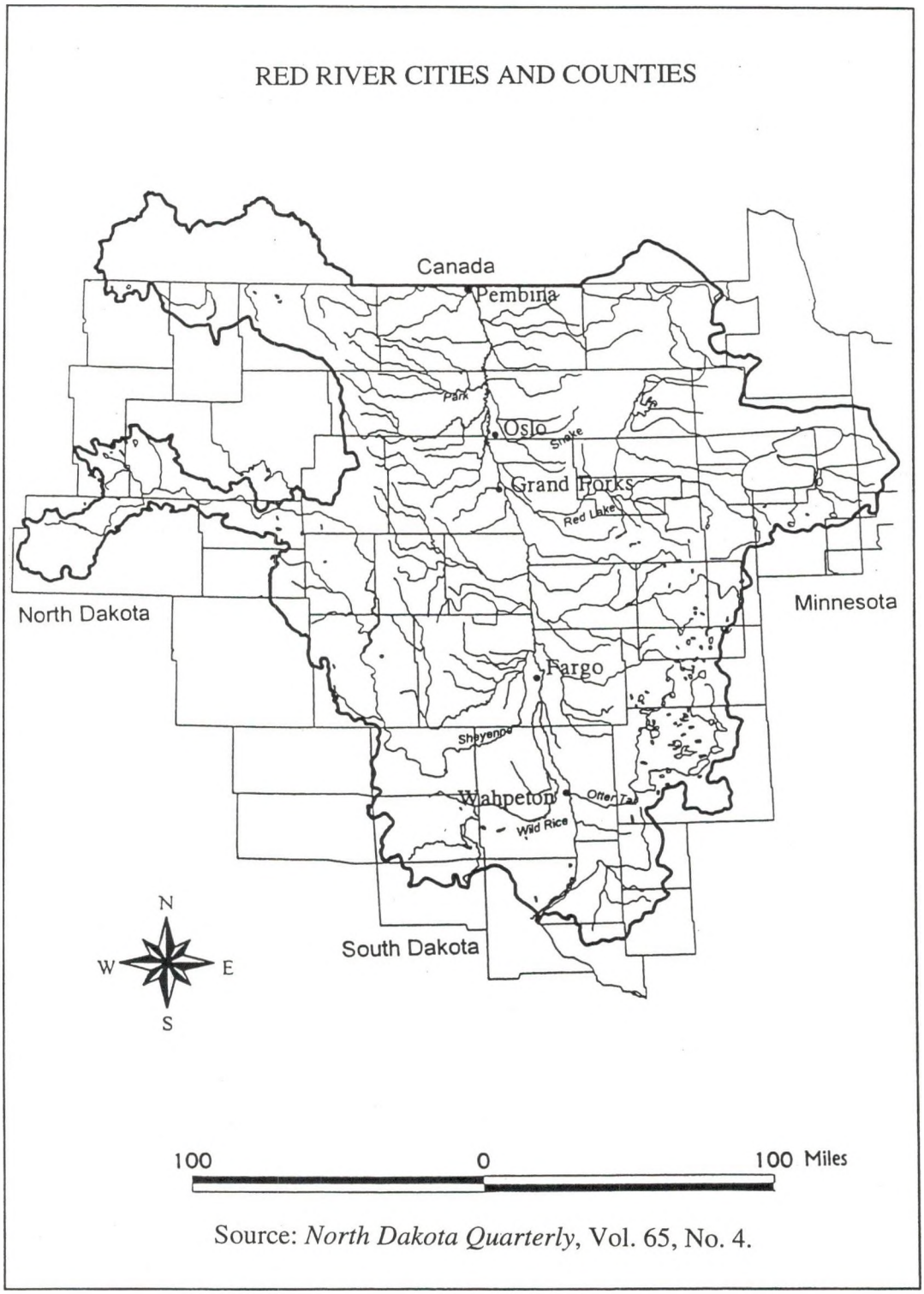
SUB BASINS

STRUCTURAL MODIFICATIONS

GAGE LOCATIONS

GRAND FORKS GROWTH

Map 4. Cities and county lines in the Red River Valley.

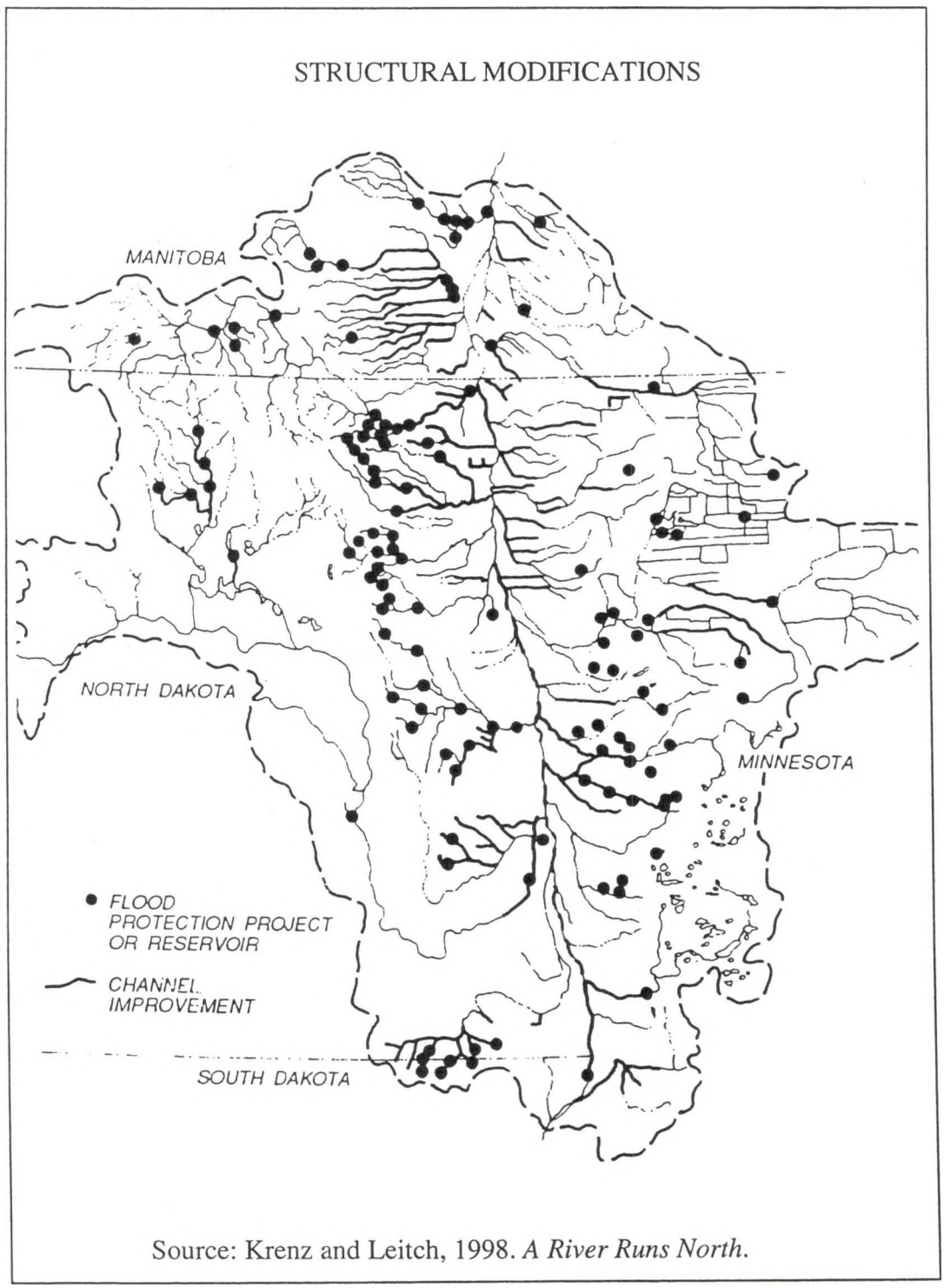


Source: *North Dakota Quarterly*, Vol. 65, No. 4.

Map 5. Red River Sub-basins.

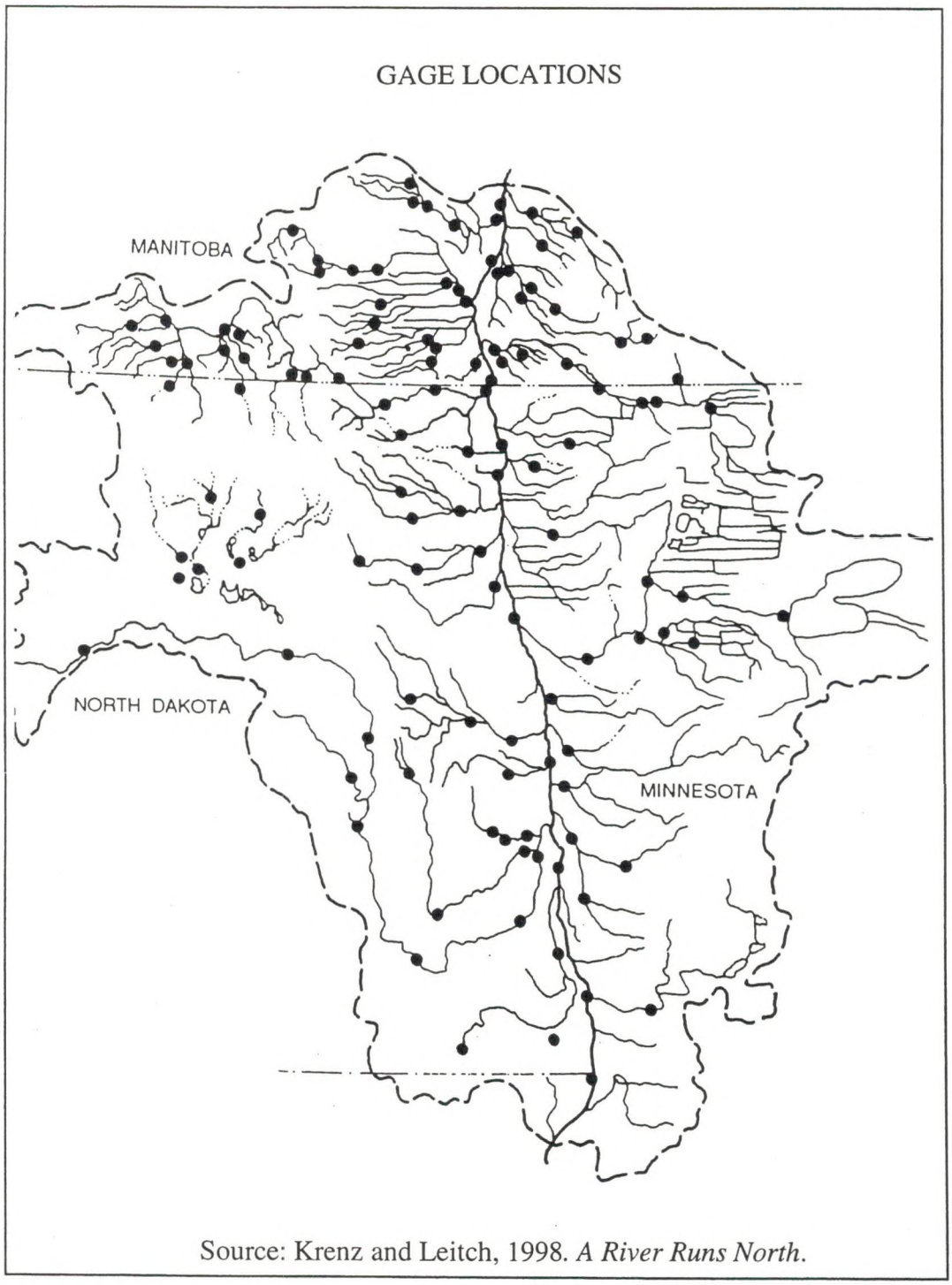
Source: Krenz and Leitch, 1998. *A River Runs North.*

Map 6. Structural Modifications in the Red River Basin.



Source: Krenz and Leitch, 1998. *A River Runs North.*

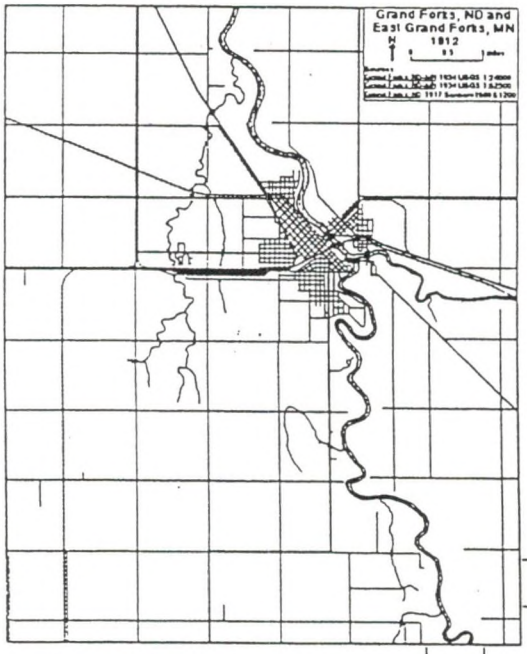
Map 7. Gage locations in the Red River basin.



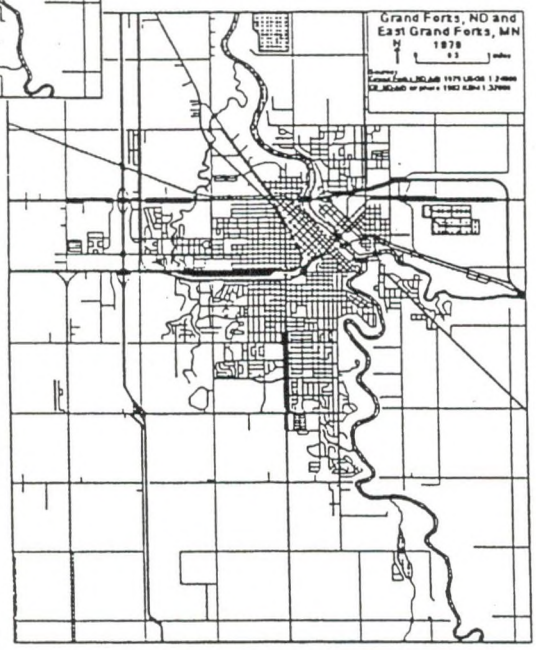
Source: Krenz and Leitch, 1998. *A River Runs North.*

GRAND FORKS GROWTH

Source: Hampsten, 1994.



Grand Forks in 1912



Grand Forks in 1979

Map 8. Urban growth at the fork of the Red River of the North and the Red Lake River.

APPENDIX G

TABLES OF FLOOD DATA

US Army Corps of Engineers

US Army Corps of Engineers

St Paul District
Spring Flood of 1997 Summary

Updated: December 11, 1997

River	Location	Gage Zero NGVD 1929	Stage at Crest	Date of Crest	Crest Elevation
Red River of the North Basin					
Red River	Wahpeton, ND	942.97	19.42 19.22	06 Apr 17 Apr	962.39 962.19
Red River	Fargo, ND	861.80	37.61 39.62	12 Apr 18 Apr	899.41 901.42
Red River	Halstad, MN	826.65	40.74	19 Apr	867.39
Red River	Grand Forks, ND	779.00	54.35	22 Apr	833.35
Red River	Oslo, MN	772.65	38.1	23 Apr	810.75
Red River	Drayton, ND	755.00	45.56	25 Apr	800.56
Red River	Pembina, ND	739.45	54.94	26 Apr	794.39
Pembina River	Neche, ND	809.69	24.51 23.93	21 Apr 26 Apr	834.44 833.62
Wild Rice River, ND	Abercrombie, ND	907.94	27.3 25.12	06 Apr 17 Apr	935.24 933.06
Sheyenne River	Valley City, ND	1199.27	16.5 18.70	05 Apr 19 Apr	1215.77 1217.97
Sheyenne River	Lisbon, ND	1066.46	19.29 18.60	05 Apr 23 Apr	1085.75 1085.06
Sheyenne River	Kindred, ND	925.55	22.04 21.27	08 Apr 30 Apr	947.59 946.82
Sheyenne River	West Fargo, ND	Zero = 870.00 Adjustment = +6.78	23.2	09 Apr	899.98

Maple River	Enderlin, ND	1056.72	15.4 14.1	04 Apr 16 Apr	1072.12 1070.82
Maple River	Mapleton, ND	895.06	15.5 13.4	05 Apr 16 Apr	910.56 908.46
Buffalo River	Dilworth, MN	878.31	27.1 22.86	06 Apr 17 Apr	905.41 901.17
Wild Rice River, MN	Twin Valley, MN	1008.16	13.77 15.27	04 Apr 15 Apr	1021.93 1023.43
Wild Rice River, MN	Hendrum, MN	836.75	33.73	18 Apr	870.48
Marsh River	Shelly, MN	841.14	22.73 25.7	10 Apr 20 Apr	863.87 866.84
Sandhill River	Beltrami, MN	883.50	19.0 18.0	08 Apr 16 Apr	902.50 901.50
Red Lake River	High Landing, MN	1141.57	12.35 10.72	10 Apr 15 Apr	1153.92 1152.29
Red Lake River	Crookston, MN	832.72	24.60 28.40	07 Apr 17 Apr	857.32 861.12
Snake River	Warren, MN		851.90	19 Apr	851.90
Snake River	Alvarado, MN	800.00	10.6	21 Apr	810.6
Two Rivers	Hallock, MN		810.6	21 Apr	810.6
Roseau River	Roseau, MN	1026.14	~20.0	20 Apr	1046.14
Park River	Grafton, ND	811.0	15.37	21 Apr	826.37

Table 6. NWS History of Outlooks.The table lists the predicted crests and the observed crests for key locations in recent years.

http://tgsv5.nws.noaa.gov/oh/Dis_Svy/RcdR_Apr97/Forecasting.htm

Year	Location	Outlook Crest No Future Precipitation *(ft)*	Outlook Crest Average Future Precipitation *(ft)*	Observed Crest Stage *(ft)*
1980	Wahpeton, ND	6.0	11.0	10.7
	Fargo, ND	15.5	21.0	20.7
	E. Grand Forks, MN	20.0	31.0	31.0
1982	Wahpeton, ND	11.0	13.5	12.0
	Fargo, ND	22.0	30.02	25.0
	E. Grand Forks, MN	32.0	42.0	37.1
1984	Wahpeton, ND	7.0	10.0	13.4
	Fargo, ND	17.0	22.02	28.3
	E. Grand Forks, MN	25.0	36.0	38.2
1985	Wahpeton, ND	7.0	10.5	9.3
	Fargo, ND	17.5	22.01	17.8
	E. Grand Forks, MN	28.0	35.0	25.8
1986	Wahpeton, ND	11.0	14.0	14.3

	Fargo, ND	22.0	28.0	27.1
	E. Grand Forks, MN	32.0	39.0	37.9
1987	Wahpeton, ND	no outlook		
	Fargo, ND	no outlook		
	E. Grand Forks, MN	32.0	34.0	33.1
1989	Wahpeton, ND	10.0	13.0	17.8
	Fargo, ND	20.0	28.03	35.3
	E. Grand Forks, MN	31.0	40.04	44.3
1993	Wahpeton, ND	10.0	14.0	14.3
	Fargo, ND	20.5	27.52	28.2
	E. Grand Forks, MN	27.0	37.5	35.6
1994	Wahpeton, ND	14.0	16.0	13.3
	Fargo, ND	30.0	34.52	26.7
	E. Grand Forks, MN	39.0	42.0	33.0
1995	Wahpeton, ND	11.0	13.5	14.8
	Fargo, ND	26.0	29.02	28.4
	E. Grand Forks, MN	35.0	37.0	37.8
1996	Wahpeton, ND	11.0	14.0	13.5
	Fargo, ND	24.0	28.02	28.7
	E. Grand Forks, MN	40.0	44.54	45.8
1997	Wahpeton, ND	17.0	18.5	19.2
	Fargo, ND	36.0	37.53	39.5
	E. Grand Forks, MN	47.5	49.0	54.3

Table 7. NWS SUMMARY The table lists flood stages for several locations on the Red River during the Flood of 1997.

Location	Flood Stage (ft)	Flood of Record Date	1997 Crest Date	Difference of flood of record and 1997 crest
Wahpeton, ND	10	17.95 4/5/89	19.44 4/6/97 & 4/15/97(*)	+1.49
Fargo, ND	17	37.3 4/15/69	39.72 4/18/97	+2.42
Halstad, MN	24	39.0 4/22/79`	40.78 4/19/97	+1.78
East Grand Forks, MN	28	48.8 4/26/79	54.35 4/22/97	+5.55
Oslo, MN	28	38.6 4/26/79	38.1 4/23/97	-0.5
Drayton, ND	32	43.7 4/28/79	45.55 4/24/97	+1.85
Pembina, ND	42	53.8 5/1/79	54.9 4/26/97	+1.1

* Wahpeton, North Dakota, at the southern end of the Red River of the North, established a new record on April 6, then another crest at or above this on April 15; the high water mark from these two crests is 19.44 feet.

Source: National Weather Service Disaster Survey Report @ http://www.nws.noaa.gov/oh/Dis_svy/RedR_Apr 97

Table 8. Natural Disasters of the Century Selected events from every part of the globe show the vulnerability to natural hazards.

NATURAL DISASTERS OF THE CENTURY*

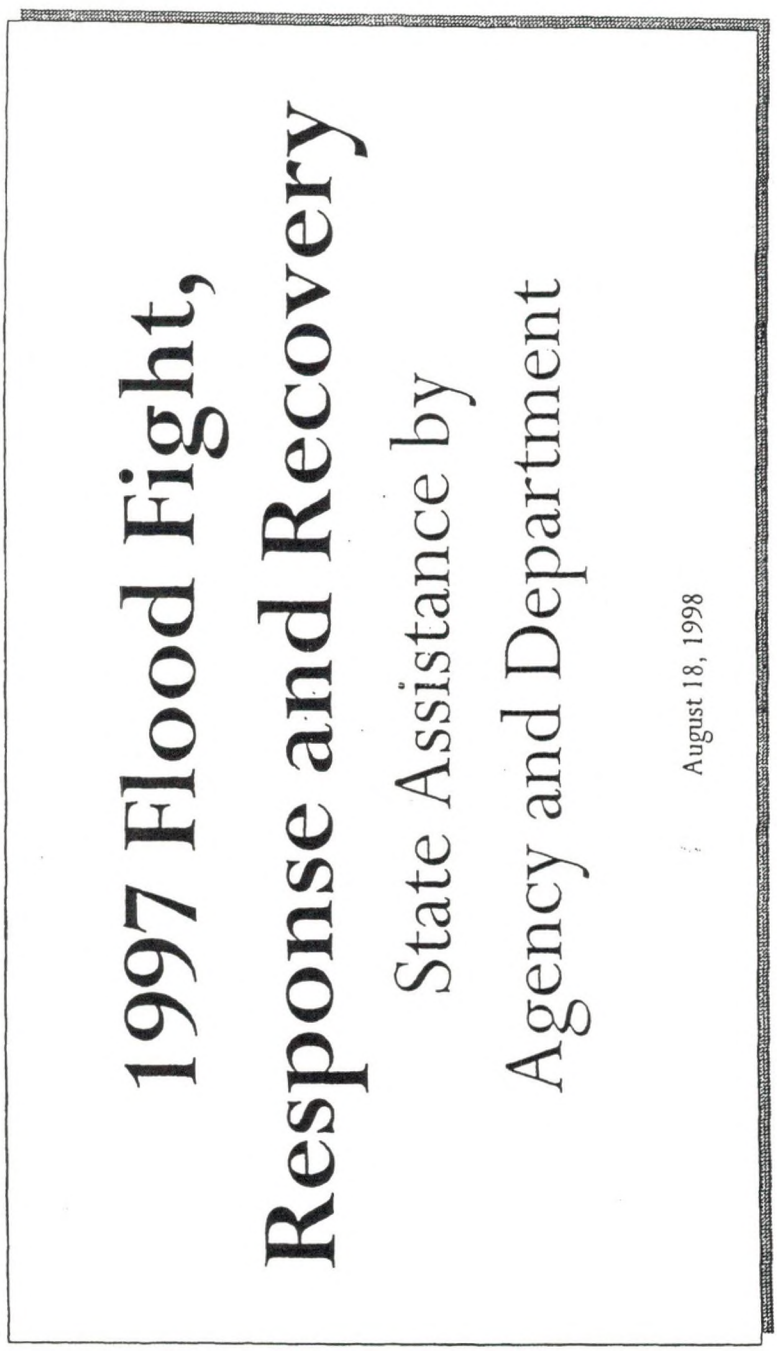
Year	Event	Location	Approximate Death Toll
1900	Hurricane	USA	6,000
1902	Volcanic Eruption	Martinique	29,000
1902	Volcanic Eruption	Guatemala	6,000
1906	Typhoon	Hong Kong	10,000
1906	Earthquake	Taiwan	6,000
1906	Earthquake/Fire	USA	1,500
1908	Earthquake	Italy	75,000
1911	Volcanic Eruption	Philippines	1,300
1915	Earthquake	Italy	30,000
1916	Landslide	Italy, Austria	10,000
1919	Volcanic Eruption	Indonesia	5,200
1920	Earthquake/Landslide	China	200,000
1923	Earthquake/Fire	Japan	143,000
1928	Hurricane/Flood	USA	2,000
1930	Volcanic Eruption	Indonesia	1,400
1932	Earthquake	China	70,000
1933	Tsunami	Japan	3,000
1935	Earthquake	India	60,000
1938	Hurricane	USA	600
1939	Earthquake/Tsunami	Chile	30,000
1945	Floods/Landslides	Japan	1,200
1946	Tsunami	Japan	1,400
1948	Earthquake	USSR	100,000
1949	Floods	China	57,000
1949	Earthquake/Landslide	USSR	12,000-20,000
1951	Volcanic Eruption	Papua New Guinea	2,900
1953	Floods	North Sea coast (Europe)	1,800
1954	Landslide	Austria	200
1954	Floods	China	40,000
1959	Typhoon	Japan	4,600
1960	Earthquake	Morocco	12,000
1961	Typhoon	Hong Kong	400
1962	Landslide	Peru	4,000-5,000
1962	Earthquake	Iran	12,000
1963	Tropical Cyclone	Bangladesh	22,000
1963	Volcanic Eruption	Indonesia	1,200
1963	Landslide	Italy	2,000
1965	Tropical Cyclone	Bangladesh	17,000
1965	Tropical Cyclone	Bangladesh	30,000
1965	Tropical Cyclone	Bangladesh	10,000
1968	Earthquake	Iran	12,000
1970	Earthquake/Landslide	Peru	70,000
1970	Tropical Cyclone	Bangladesh	300,000-500,000
1971	Tropical Cyclone	India	10,000-25,000
1976	Earthquake	China	250,000
1976	Earthquake	Guatemala	24,000
1976	Earthquake	Italy	900
1977	Tropical Cyclone	India	20,000
1978	Earthquake	Iran	25,000
1982	Volcanic Eruption	Mexico	1,700
1985	Tropical Cyclone	Bangladesh	10,000
1985	Earthquake	Mexico	10,000
1985	Volcanic Eruption	Colombia	22,000
1987	Wildfire	China	200

* Disasters selected to represent global vulnerability to rapid-onset natural disasters.

Source: Confronting Natural Disasters, International Decade for Natural Hazard Reduction, National Research Council, 1987.

APPENDIX H

STATE ASSISTANCE FOR RESPONSE AND RECOVERY



Agency/Department Agency/Department Head	Address	Summary of Assistance Provided
Governor's Office Governor Ed Schafer	1st Floor, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2200	• Coordinated efforts of all agencies involved in disaster response and recovery
Adjutant General & National Guard Major General Keith Bjerke	Fraine Barracks Box 5511 Bismarck, ND 58502 (701) 224-5102	• Governor's representative for disaster response and recovery efforts • Coordinated all ND National Guard operations
Division of Emergency Management Douglas Friez, Division Director	Fraine Barracks Bldg 40 Box 5511 Bismarck, ND 58506 (701) 328-3300	• Coordinated efforts of the ND National Guard and Department of Transportation during flood fight and recovery in accordance with the State Emergency Operations Plan (SEOP). • Worked to obtain funding for flood fighting operations including ice-dusting and a flood preparedness public service campaign. • State Emergency Operations Center coordinated efforts of all emergency response agencies • Coordinated with FEMA to ensure smooth disaster response and recovery, including the establishment of the Individual and Family Grant Program (which involved employing 30 applicant processors and five clerical workers and awarding approximately $15 Million with over 20,000 cases.) • Following the Presidential Disaster Declaration, established individual and public assistance programs in conjunction with FEMA. • Managed the Hazard Mitigation Grant Program to prevent future flood damages • Worked extended hours and hired over 40 temporary employees to help with administering the Public Assistance, Hazard Mitigation and Individual and Family Grant Programs

Attorney General's Office Heidi Heitkamp, ND Attorney General	1st Floor, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2210	♦ State Fire Marshal: ♦ Distributed public fire safety information ♦ Assisted in the investigation of the fire ♦ Criminal Regulatory Division including the Licensing Station: ♦ Provided advice to local law enforcement and legal support to the Grand Forks City Attorney and Grand Forks County State's Attorney ♦ Licensing Station helped establish "one-stop-shop" to assure that contractors and their employees working in Grand Forks were properly registered with the various state ♦ Participated in a training session for lawyers on flood disaster legal issues ♦ Held a Public Flood Forum to inform GF consumers of flood related scams ♦ Consumer Protection and Antitrust Division: ♦ Provided information to consumers concerning scams using brochures and other media ♦ Finance and Administration Division and Attorney General Administration: ♦ Provided computer expertise regarding connectivity into various state agency databases ♦ Bureau of Criminal Investigation: ♦ Established and coordinated a pool of law enforcement officers from ND, MN, SD and PA who were available to relieve and supplement local law enforcement ♦ Assisted local law enforcement ♦ Provided staff and resources assisting clean-up efforts in officer's homes ♦ Fire Marshal and Bureau of Criminal Investigation provided use of the command post vehicle ♦ Legal Divisions: ♦ Assisted Health Department with debris removal ♦ Assisted Health Dept to bring back drinkable water system ♦ Mitigated post-disaster legal problems by researching problems encountered in previous disasters ♦ Provided legal support to the City Attorney ♦ Expended over $120,000 in providing statewide assistance
Bank of North Dakota John Hoeven, President	7th & Main Box 5509 Bismarck, ND 58506 (701) 328-5681	♦ Established $15 million line of credit to ND Emergency Management and $10 million line of credit to the Adjutant General of the ND Army National Guard ♦ Established the *Disaster Relief Loan Program* totaling $30 million to GF ♦ Established a $25 million line of credit to the City of Grand Forks ♦ Established a $12 million line of credit to UND ♦ Established an $8.3 million line of credit to GF Public School System ♦ Supported coordination of the '97 Flood Relief fund of the North Dakota Community Foundation and served as a central deposit base ♦ Sponsored employee flood donation drive

Economic Development and Finance Kevin Cramer, Director	1833 E. Bismarck Expressway Bismarck, ND 58504 (701) 328-5300	♦ Participated in establishing a "One Stop Capital Center" ♦ Provided short term working capital to local companies ♦ Development Fund established a $2 Million disaster recovery fund ♦ Hired a consultant to study the disaster's impact and recovery strategies
State Electrical Board Donald Offerdahl, Executive Director	721 Memorial Highway P.O. Box 857 Bismarck, ND 58502 (701) 328-9522	♦ Sent news release to all media providing information on flood-damaged wiring repair ♦ Coordinated with NSP, Cass County Electric and Nodak Electric ♦ Coordinated volunteers to verify dry basements and sent six state inspectors to Grand Forks
Game and Fish Dean Hildebrand, Director	100 N. Bismarck Expressway Bismarck, ND 58501 (701) 328-6345	♦ Provided a Cessna 182 RG for air transportation ♦ Responded to request from Sheriff's Office for 11 Wardens and 1 Supervisor to assist in several missions: ♦ Assisted in the evacuation of government offices ♦ Assisted individuals and escorted VIPs on land and aerial tours ♦ Conducted night and aerial surveillance ♦ Expended over $16,000 in response missions
State Health Department Murray Sagsveen, State Health Officer	600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2372	♦ State Health Officer Jon Rice, M.D., assisted with evacuation of the medical park complex, provided on-site support to community and public health officials ♦ Worked with FEMA and City Health Department to prepare 25,000 cleanup kits to supplement American Red Cross & Salvation Army kits ♦ 308 ND Department of Health Workdays were dedicated to the flood response efforts between April 18 and May 7, 1997 ♦ Helped to coordinate the transportation and lodgings of long-term care residents of Grand Forks and followed up on those affected ♦ Supplied more than 25,000 tetanus vaccinations to local health department. ♦ The Division of Disease Control established an illness and injury surveillance program at Altru Health Systems ♦ Assisted with the restoration of drinking water ♦ Helped to develop plan for safe debris removal ♦ Division of Health Facilities monitored the return of residents to Valley Eldercare and conducted an onsite inspection ♦ Monitored Altru Health Systems for ongoing risks

Highway Patrol Colonel James Hughes	Judicial Wing, Sate Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2455	• Established the "Cops Helping Cops" program that provided donation location for nationwide officers wanting to help • Assigned Troopers to assist GFPD with security • Worked with local officials with response and recovery efforts • Assisted Air and Army National Guard with road closures • Provided temporary housing for additional personnel and troopers and their families relocated by the flood
Human Services Carol Olson, Executive Director	Judicial Wing, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2310	• Provided personnel and equipment to assist with evacuation of over 700 elderly from the Air Force Base • Applied for federal waiver to simplify Medicaid procedures • Provided technical infrastructure and assistance to GF County Social Services • Issued $834,221 in emergency food stamps to 3,486 households (7,625 persons) • Provided emergency placement of disabled • Allocated $24,000 for non-traditional services • Earmarked $105,000 for emergency temporary child care (As of May, 1997, the # of child care providers had dropped from 225 to 47) • Have continued seeking funding and operating programs for ongoing post-disaster related problems • Statewide disaster related expenses are estimated at $18.3 million and continue to grow
Office of Intergovernmental Assistance Dina Butcher, Director	14th Floor, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-4499	• Designated by Governor Ed Schafer as the link between City of Grand Forks and FEMA on emergency housing • Obtained necessary program waivers to expedite the use of CDBG, HOME and supplemental funds on disaster related projects • Worked with the State Health Department and the Department of Parks and Recreation to identify available campsites and mobile home parks to site campers and manufactured housing • Worked with the City and UND to determine off-campus housing needs for students and other residents. The OIA redistributed $1 Million of its CDBG funds and $1.4 million of HOME funds to jump start the rehabilitation of rental housing units • Worked with the Hazard Mitigation Team to develop procedures for assistance • Distributed $669,200 of Energy Program funds for rebates for the purchase of 3,346 high energy efficient models • Continues working with EDA grants to coordinated flood recovery efforts with three regional councils and to assist the ND Water Commission in developing long term mitigation planning for the Red River Corridor • Director and staff spent from 10% to 85% time working on related projects

North Dakota Job Service Jennifer Gladden, Executive Director	1000 East Divide Ave. P.O. Box 5505 Bismarck, ND 58506 (701) 328-2836	♦ Staff in offices statewide worked extended hours and weekends to handle over 12,000 claims by August 15, 1997 alone ♦ Coordinated volunteers from other state's employment offices ♦ Coordinated a "one stop shop" for construction companies coming into the region to prevent influx of scams and fraud ♦ Created a centralized employment office including a crisis management team composed of local managers, directors and staff from throughout the agency ♦ Immediately rerouted calls to Minot office and added toll-free lines, as well as establishing a temporary office in Larimore ♦ Travel and per diem status was granted for GF staff ♦ Relocated staff to GF office after it was able to open and added emergency temporary staff ♦ Managed Disaster Assistance Program and Summer Youth Employment and Training Program ♦ Funded a special Business Census survey of all employers to assess employment needs ♦ Expedited the process for non-citizen workers to fill job needs ♦ Held job fairs, published a disaster recovery work application in the newspaper, established a consumer hotline listing approved contractors and provided several other employer/employee lists to coordinate needs with availability
Labor Department Craig Hagen, Commissioner	13th Floor, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2660	♦ Assisted with gaining federal funding for flood fight and recovery by performing an assessment of all State agencies and producing revenue forecasts for economic impact on several areas including agriculture, real estate and construction ♦ Marshaled federal and state resources to meet costs ♦ Coordinated disaster spending procedures with Bank of North Dakota, emergency Commission and Moody's and S&P bond rating indices
ND League of Cities Connie Sprynczynatyk	Box 2235 Bismarck, ND 58502 (701) 223-3518	♦ Acted as Governor's appointed representative for state-wide donations management as of April 23, 1997 ♦ Provided staff to coordinate state donations system ♦ Established and managed donations hotline

Office of Management & Budget
Rod Backman, Director
	4th Floor, State Capitol
	600 E. Blvd Ave.
	Bismarck, ND 58505
	(701) 328-4904
		• OMB has an ongoing commitment with the recovery in Grand Forks including securing funds for State Matches on mitigation and recovery projects.
		• OMB's work with the flood fight and recovery primarily occurred within the departments below:
		• **Fiscal Management Division**
		  • Assisted with gaining federal funding for flood fight and recovery by performing an assessment of all State agencies and producing a revenue forecast for economic impact on several areas including agriculture, real estate and construction
		  • Continue to marshal resources for ongoing funding needs
		  • Assisted Grand Forks Schools with funding needs
		  • Coordinated disaster spending procedures with Bank of North Dakota, Emergency Commission and Moody's and Standard and Poor's bond rating indices
		• **Risk Management Division**
		  • Met with City, County, National Guard and ND Judge Advocate General to discuss legal processes involved and worked to facilitate proceedings
		  • Drafted Disaster Relief Agreements between the State and the City and the State and the County and provided local authorities proposed authorizations for Debris Removal forms
		• **Information Services Division**
		  • Relocated local informational services to Larimore, including Job Services, DOT, Social Services
		  • Provided tech service and programming support as well as working with US West and AT&T on technological support for the establishment of data and voice services
		  • Offered tech service programming support along with computer services for payroll applications when UND's mainframe was shipped to NDSU
		• **Facility Management Division**
		  • Coordinated logistics for a flood relief donations site with the American Red Cross and Salvation Army
		  • Facilitated the collection of 12 semi-trailer loads of recovery goods.
		  • Worked with volunteers to collect and disperse donated goods.
		• **Central Services Division (Three main areas)**
		  • Central Duplicating worked extra hours and weekends and provided on-demand services for necessary printed materials and forms
		  • Surplus Property obtained 482,000 sandbags from Japan and distributed them as well as collecting food supplies and generators
		  • State purchasing prioritized and handled emergency purchases for State agencies
		• **Central Personnel Division**
		  • Worked to clarify and administer extraordinary employment policy situations
		Continued. . .

Office of Management & Budget, continued		• State Radio Communications Division
		  • Furnished all areas needed radio equipment used by law enforcement, DEM, FEMA and others
		  • Handled all County 911 calls from April 18 to June
		  • Worked with the National Crime Information Center and the State Criminal Warrant Information System to ensure licensing validity and minimize post-disaster fraud and scams: Several people were arrested
		  • Provided staff and assistance as well as coordinating the relocation of law enforcement data circuits into new, permanent locations

Department of Public Instruction
Dr. Wayne Sanstead, State Superintendent
	9th,10th, 11th Floors, State Capitol
	600 E. Blvd Ave.
	Bismarck, ND 58505
	(701) 328-4572
		• Focused on student transportation and continued educational attendance:
		  • Ensured all ND school districts would accept and receive compensation for accepting flood displaced students
		  • Coordinated similar agreement with Minnesota school districts
		  • Coordinated distribution of 23 semi-trucks of USDA school lunch food stocks to American Red Cross and Salvation Army relief shelters
		  • Worked with USDA to provide all children displaced by the flood with free breakfasts and lunches at host schools for the duration of the 1996-97 term. (This resulted in 2600 children receiving 2621 free breakfasts and 40,567 free lunches in April and May 1997)
		  • Assisted school districts in locating construction management firms and other specialized flood recovery capabilities
		  • Worked through Child Care Food Program and Summer Food Service Program through which the GF Park District was able to provide 6400 meals

Secretary of State Alvin Jaeger, Secretary of State	1st Floor, State Capitol 600 E. Blvd Ave. Bismarck ND 58505 (701) 328-2900	• Responsible for the licensing of all contractors; worked with Attorney General's office, Worker's Compensations Bureau, Job Service ND and the City of GF to establish a "one-stop-shop" for licensing contractors • Had two staff members at the "one-stop-shop" • Expended nearly $15,000 for staffing and equipment.

Office of State Tax Commissioner Rick Clayburgh, Tax Commissioner	7th, 8th ,16th Floors, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2770	• Granted numerous extensions for filing tax returns • Waived all penalty and interest on returns filed during the extension periods • Identified property tax statutes that could be suspended by executive order allowing adjustments t6o property valuations by the assessor • Visited Grand Forks and East Grand Forks businesses during the sales tax return extension period if the sales taxpayer had been unable to file a sales tax return • Attended meetings organized by the Secretary of State to discuss actions that could be take n to assist businesses and individuals in the Grand Forks area • Temporarily suspended compliance and audit activities in the flooded areas • Responded to requests from taxpayers for copies of previously filed income, sales and income tax withholding returns needed to replace lost records • Provided assistance to researchers completing the Grand Forks Business Emergency Census • Prepared revised revenue forecasts • Initiated payment agreements with taxpayers that were unable to pay taxes because of the disaster
Department of Transportation Marshall Moore, Director	608 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2581	• Provided much of the equipment used in building the dike on Washington St. • Committed approximately 230 employees to the flood disaster • Provided 80 trucks, numerous front-end loaders, and backhoes for flood work in the Red River Valley • Supported the Emergency Operations Center on a 24-hour basis for nearly two weeks • Coordinated with county water resource districts and county commissions on a daily basis with technical information including recommendations on reducing flood problems, assistance regarding permits, and aerial reconnaissance and site visits to problem areas • Engineers assisted in the location and construction of the Washington Street emergency dike • Answered several hundred phone calls and inquiries regarding flood insurance from homeowners, cities, and insurance agents • Worked closely with the Corps and the City regarding emergency dike alignments and permits • Provided assistance to the City of Grand Forks and the National Guard as an emergency water supply was being developed for Grand Forks • Met with city officials and Corps staff regarding alternative flood projects and locations

University System Larry Isaak, Chancellor	10th Floor, State Capitol 600 E. Blvd Ave. Bismarck, ND 58505 (701) 328-2962	♦ Worked with Statewide universities to provide assistance in the form of facilities, equipment and goods to the disaster affected
Workers Compensation Bureau Pat Traynor, Executive Director	500 E. Front Ave. Bismarck, ND 58504 (701) 328-3800	♦ Assisted with "one-stop-shop" to assure contractors and their employees working in Grand Forks were properly registered with the various state agencies and were complying with requirements of each department ♦ Six staff members from the Bureau worked at the Grand Forks location for several months ♦ From the Grand Forks location, the Bureau opened 101 new employer accounts

APPENDIX I

FEMA ASSISSTANCE PROGRAMS

MN/ND/SD FEDERAL RECOVERY TASK FORCE
AGENCY PROGRAMS & FUNDING STATUS

COMPREHENSIVE FLOOD HAZARD MITIGATION

Comprehensive Flood Hazard Mitigation Planning

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Flood Control/Advance Measures/Emergency Operations/Rehabilitation & Restoration	Services	USACE	*Additional funding in Supplemental*
Continuing Authorities & other Programs (CAP)	Cost-Share	USACE	*Authorization and funding may be needed*
Flood Plain Management Services (FPMS)	Technical Assistance	USACE	
Planning Assistance to States (PAS) Program	Technical Assistance	USACE	
Community Development Block Grant (CDBG) Program	Grant	HUD	*Additional funding in Supplemental*
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*

Structural Flood Control Measures

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Flood Damage Reduction Program	Cost-Share	USACE	*Authorization and funding needed*
Emergency Watershed Protection Program (EWP)	Grant	USDA-NRCS	*Additional funding in Supplemental*
Small Watershed Program	Technical Assistance/Grant	USDA-NRCS	
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*
Community Development Block Grant (CDBG) Program	Grant	HUD	*Additional funding in Supplemental*

Non-Structural Flood Control Measures

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*
Public Assistance Program (PA) – Section 406	Cost-share Grant	FEMA	*Additional funding in Supplemental*
Flood Mitigation Assistance (FMA)	Cost-Share Grant	FEMA	
Flood Damage Reduction Program	Cost-Share	USACE	*Authorization and funding needed*
Continuing Authorities & other Programs (CAP)	Cost-Share	USACE	*Authorization and funding may be needed*
Community Development Block Grant (CDBG) Program	Grant	HUD	*Additional funding in Supplemental*
Small Watershed Program	Technical Assistance/Grant	USDA-NRCS	
Emergency Watershed Protection Program (EWP)	Grant	USDA-NRCS	*Additional funding in Supplemental*
Land and Water Conservation Fund	Land Purchase	DOI-USFWS	
Partners for Wildlife	Grants & Technical Assistance	DOI-USFWS	
National Wildlife Refuge Acquisition Program	Land Purchase	DOI-USFWS	
Rivers, Trails & Conservation Assistance Program (RTCA)	Technical Assistance	DOI-NPS	*Limited funding - no Supplemental funding pending*
Conservation Reserve Program	Easements	USDA-FSA	
Clean Water Act	Grant	EPA	

Federal Lands-to-Parks Program	Technical Assistance/ Surplus Property	DOI-NPS	*Limited funding - no Supplemental funding pending*
Wild and Scenic River [section2(a)(ii) & section 5(d) inventory]	Technical Assistance	DOI-NPS	*Limited funding - no Supplemental funding pending*
North American Wetlands Conservation Fund	Grants	DOI-USFWS	
Migratory Bird Conservation Fund	Land Purchase	DOI-USFWS	
Small Wetlands Acquisition Program	Land Purchase	DOI-USFWS	

Housing Repairs, Rehabilitation and Reconstruction/Replacement Financing

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Temporary Housing Assistance Program	Grant	FEMA	*Additional funding in Supplemental*
Home Disaster Loan Program	Subsidized Loan	SBA	
Weatherization Assistance Program	Formula Grant	DOE	*Funding amount is at the discretion of the affected States*
Partnerships for Affordable Housing	Technical Assistance	DOE	
Building America Program	Technical Assistance	DOE	
Very Low-Income Repair Loans	Grant/Loan	USDA-RHS	*Additional funding in Supplemental*
Mutual and Self Help Grants	Grant	USDA-RHS	
Single Family Direct and Guaranteed Loans	Loan	USDA-RHS	
Rural Rental Housing Loans	Loan	USDA-RHS	
Inspection of RHS-financed properties	Services	USDA-RHS	
Housing Counseling	Services	HUD	
Title I Home Repair Loan Program	Loan	HUD	
Single-Family Mortgage Insurance Program – FHA Section 203 (h)	Loan Guarantee	HUD	
Single-Family Rehabilitation Mortgage Insurance Program - FHA Section 203(k)	Mortgage Insurance	HUD	
Community Development Block Grant (CDBG) Program	Grant	HUD	*Additional funding in Supplemental*
HOME Investment Partnership Program	Loan	HUD	
Section 8 Housing	Grant	HUD	
Public Housing Modernization Reserve for Emergencies and Disasters	Grant	HUD	
Federal Home Loan Bank	Subsidized Loans	HUD	

NATIONAL FLOOD INSURANCE PROGRAM (NFIP), FLOODPLAIN MANAGEMENT, INSURANCE & MAPPING

NFIP/Floodplain Management and Insurance Programs

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
National Flood Insurance Program (NFIP)	Insurance	FEMA	*Legislation proposed to increase borrowing authority*
Flood Plain Management Services (FPMS)	Technical Assistance	USACE	

NFIP Mapping

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
National Flood Insurance Program (NFIP)	Insurance	FEMA	*Legislation proposed to increase borrowing authority*

PLANNING FOR ECONOMIC RECOVERY

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
National Flood Insurance Program (NFIP)	Insurance	FEMA	***Legislation proposed to increase borrowing authority***
Flood Plain Management Services (FPMS)	Technical Assistance	USACE	

Planning, Project Development and Loan Packaging

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Community Development Block Grant (CDBG) Program	Grant	HUD	***Additional funding in Supplemental***
HUD Planning and Technical Assistance	Technical Assistance	HUD	
Title III Planning and Technical Assistance	Grant	DOC-EDA	***Funding in current Supplemental***
Center of Excellence for Sustainable Development	Technical Assistance	DOE	
Center of Excellence for Natural Disaster Remediation	Technical Assistance	DOE	
Office of Energy Efficiency and Renewable Energy	Technical Assistance	DOE	
Service Corps of Retired Executives (SCORE)	Volunteer Services	SBA	
Small Business Development Centers (SBDC)	Services	SBA	
Business Information Centers (BICs)	Technical Assistance	SBA	
Water and Waste Program	Grants/Loans	USDA-RUS	

Business Financing

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Business Disaster Loan Program	Subsidized Loan	SBA	
Economic Injury Disaster Loans (EIDL)	Loan	SBA	
Revolving Loan Fund Program	Grant/Loan	DOC-EDA	***Additional funding in Supplemental***
Community Development Block Grant (CDBG) Program	Grant	HUD	***Additional funding in Supplemental***
Business and Industrial Loan Program	Loan	USDA-RBS	***Limited funding available***

Program for Economic Recovery and Redevelopment

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Title IX Grants	Grant	DOC-EDA	***Funding in Supplemental***
Community Development Block Grant (CDBG) Program	Grant	HUD	***Additional funding in Supplemental***
Community Facilities	Grant/Loan/ Guaranteed Loan	USDA-RHS	***Limited funding available***
Community Disaster Loan Program (CDL)	Loan with possible conversion to grant	FEMA	***Limited current loan authority – additional loan authority in Senate Supplemental***
Rural Business Enterprise Grants	Grants	USDA-RBS	***Limited funding available***
Various Programs to Promote the Rural Business Climate	Grant/Loan/ Guaranteed Loan	USDA-RBS	

Employment

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Disaster Unemployment Assistance (DUA)	Grant	DOL/ FEMA	
Unemployment Insurance (UI)	Grant	State	
Summer Jobs for Non-Disadvantaged Youth	Grant	DOL	***Additional funding needed for JTPA Title IV***
Job Training Partnership Act (JTPA) Title III – Dislocated Worker Assistance	Grant	DOL	

AGRICULTURE

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Disaster Reserve Assistance Program (DRAP)	Cost-share Grant	USDA-FSA	*Authorization needed for funding of FY 97 programs*
Emergency Loan Program	Loan	USDA-FSA	
Loan Restructuring Provisions	Service	USDA-FSA	
Guaranteed Loan Program	Loan Guarantee	USDA-FSA	*Funding in Supplemental*
Federal Crop Insurance	Insurance	USDA-RMA	
Emergency Conservation Program	Cost-Share Grant	USDA-FSA	*Funding in Supplemental*
Emergency Watershed Program (EWP)	Cost-Share Grant	USDA-NRCS	*Funding in Supplemental*
National Flood Insurance Program (NFIP)	Insurance	FEMA	*Legislation proposed to increase borrowing authority*

INFRASTRUCTURE

Transportation – roads, bridges, railroads, etc.

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Emergency Relief (ER) Program	Cost-share Grant	DOT-FHWA	*Additional funding in Supplemental*
Emergency Railroad Rehabilitation and Repair	Grant	DOT-FRA	*Additional funding in Supplemental*
Public Assistance Program (PA) – Section 406	Cost-share Grant	FEMA	*Additional funding in Supplemental*
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*

Public Buildings – schools, hospitals, civic buildings, etc.

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Public Assistance Program (PA) – Section 406	Cost-share Grant	FEMA	*Additional funding in Supplemental*
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*
Community Development Block Grant (CDBG)	Grant	HUD	*Additional funding in Supplemental*
Construction Grant Program	Grant	DOC-EDA	*Additional funding in Supplemental*

Utilities – water, sewer, etc.

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Public Assistance Program (PA) – Section 406	Cost-share Grant	FEMA	*Additional funding in Supplemental*
Hazard Mitigation Grant Program (HMGP)	Cost-Share Grant	FEMA	*Additional funding in Supplemental*
Center of Excellence for Natural Disaster Remediation	Technical Assistance	DOE	
Western Area Power Administration	Fee Waiver	DOE	
State Revolving Fund – Safe Drinking Water Act and Clean Water Act	Loan	EPA	
Construction Grant Program	Grant	DOC-EDA	*Additional funding in Supplemental*
Water and Wastewater Program	Grant/Loan/ Guaranteed Loan	USDA-RUS	*Additional Funding in Supplemental*
Rural Electric Program	Loan/ Guaranteed Loan	USDA-RUS	*Funding available*

Rural Telecommunications Program	Loan/ Guaranteed Loan	USDA-RUS	*Funding available*
Community Development Block Grant (CDBG)	Grant	HUD	*Additional funding in Supplemental*

HEALTH AND MENTAL HEALTH

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Crisis Counseling under State Extension Services	Services	USDA	
Public Health	Services	HHS	
Community Health & Mental Health	Services	HHS	
Community Social Services	Services	HHS	
Summer Youth Jobs	Services	HHS	
Crisis Counseling Assistance and Training Program (CCP)	Services	FEMA	*Additional funding in Supplemental*
Cora C. Brown Fund	Grant	FEMA	
Crisis Counseling under the State Extension Services	Service	USDA	
Food Safety Inspection/Education and Field Epidemiology Emergency Response	Services	USDA-FSIS	
Household Feeding Services (Food stamps, WIC, Commodity Foods, etc.)	Grant/ Commodities	USDA	
WWW Extension Disaster Education Network	Services	USDA	

SPECIAL NEEDS

Tribal Nations

Available Program	Type of Assistance	Agency	Funding/Authority Shortfall
Stafford Act Programs	Cost-Share Grants	FEMA	*Additional funding in Supplemental*
Emergency Relief (ER) Program (Title 23)	Cost-share Grant	DOT-FHWA	*Additional funding in Supplemental*
Indian Reservation Road (IRR) Construction Program	Discretionary Funds	DOT-FHWA	*Authority to divert funds – Supplemental would reimburse disbursed funds*
Emergency Relief of Federally-Owned Roads (ERFO)	Grant	DOT-FHWA	*Additional funding in Supplemental*
Reservation & Tribal Health	Grant	HHS	
Indian Community Development Block Grant (CBDG) Program	Grant	HUD	*$600,000 in funding available*
Indian Housing Modernization	Grant	HUD	
Planning, Technical Assistance & RLF Construction Grants	Grant	DOC-EDA	*Supplemental funding needed*
Housing Improvement Program	Grant	DOI-BIA	*Supplemental expected to be inadequate*
Indian Acute Disaster Donation Program (IADDP)	Grant	DOI-BIA	*MOU #5 between DOI & USDA needs to be more flexible*
Dam Safety	Grant	DOI-BIA	*Need authorization for spending authority*
Human Services	Grant	DOI-BIA	*Supplemental expected to be inadequate - authorization needs to be modified to handle returnees*
Law & Order	Grant	DOI-BIA	*Spending authority needs to be modified*

APPENDIX J

INTERNET WEB SITES

ftp://ftp.mvp-wc.usace.army.mil/pub/Red_River/Bridge_Summary

Red River of the North Main Stem Bridge Data Inventory

ftp://ftp.mvp-wc.usace.army.mil/pub/Red_River/Landmarks

Red River of the North Main Stem Hydraulics

http://pongo.colorado.edu/cgi-bin/AT-hazlitseardch.cgi

HazLit Search Results Using Excite

http://tgsv5.nws.noaa.gov.oh/

NWS Office of Hydrology

http://tgsv5.nws.noaa.gov/mission.html

National Weather Service Mission Statement

http://tgsv5.nws.noaa.gov/pa/special/history/125thsk.htm

NWS Celebrates 125th Anniversary

http://www.eerc.und.nodak.edu/misc/flood.html

The 1997 Red River Flood Sites

http://www.fema.gov/about/history.htm

History of the Federal Emergency Management Agency

http://www.fema.gov/aboutdisagid.htm

A Guide for Disaster Recovery Programs from FEMA NewsRoom

http://www.fema.gov/diz97/sitrep01.htm

Upper Midwest Flood Situation Report #P1 Same address for all reports

http://www.fema.gov/diz98/98124.htm

Disasters, Federal Funds Approved for North Dakota

http://www.fema.gov/fema/frmwrk2.htm

The Presidents Action Plan for Recovery

http://www.fema.gov/library/spln_1.htm

FEMA Strategic Plan for Year 2000

http://www.history.noaa.gov/menu.html

NOAA History

http://www.ijc.org/boards/rrbflood.html

International Study of Flooding in the Red River Basin

http://www.mvp.usace.army.mil/pp/gf/Report.html

EGF/GF General Reevaluation Report and Final Environmental Impact Statement

http://www.mvp.usace.army.mil/pp/info/_papers/SCOPDOCA.htm

Environmental Impact Studies for Flood Control

http://www.mvp.usace.army.mil/pp/info/EGFGF.htm

East Grand Forks, Minnesota / Grand Forks, North Dakota Flood Control Red River of the North

http://www.mvp.usace.army.mil/pp/info_papers/REDRIVER.htm

Red River Technical Resource Service – Minnesota/North Dakota

http://www.mvp-wc.usace.army.mil/links.html

Government Agency Water Resources Links

http://www.nws.noaa.gov/links.html

General Weather Information topics and Related Links

http://www.tgsv5.nws.noaa.gov/oh/Dis_Svy/RedR_Apr97/

Forecasting Methodology

http://www.und.nodak.edu/instruct/eng/fkarner/pages/flood97.htm

Earthscape Great Flood of '97

http://www.usgs.gov/public/wid/FS_209-95/mason-weiger.html

Stream Gaging and Flood Forecasting A Partnership of the U.S. Geological Survey and the National Weather Service

http://www.usgs.gov/reports/yearbooks/1992/wrd –hydrologic.html

U.S. Geological Survey Circular 1992 by David W. Morganwalp

http://www.usgs.gov/theme/FS_188-97/

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