



# Evaluating Losses Avoided Through Acquisition Projects

Moorhead, Minnesota  
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# Acknowledgements

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## **Executive Summary**

Central to the mission of the Federal Emergency Management Agency (FEMA) is to reduce losses from future disasters.

The Federal Emergency Management Agency (FEMA) awards mitigation grants to reduce the negative impact of natural hazards on property, people, and the environment. FEMA funds projects based on numerous factors, including a cost-effectiveness analysis of a range of hazard events. Presidential-declared disasters provide considerable funds to States and communities via the Hazard Mitigation Grant Program (HMGP). The HMGP assists States and local communities in implementing long-term hazard mitigation measures. It can be used to fund projects that protect public or private property. Under the HMGP, FEMA may contribute up to 75 percent of project costs. The community must formally agree to provide a local match in the amount of the remaining project costs (at least 25 percent). After significant funds are distributed for mitigation projects, the questions arise: Was the project truly cost effective? How effective was the project during ensuing disasters or hazard events?

The Loss Avoidance Study (LAS) methodology was developed by FEMA to provide a quantitative approach to assess performance of mitigation measures. This report, *Evaluating Losses Avoided through Acquisition Projects*, evaluates the effectiveness of property acquisitions as a mitigation measure. FEMA partnered with the State of Minnesota and the City of Moorhead and used the quantitative approach to complete a loss avoidance study for the acquisition projects.

The LAS methodology includes three major phases. *Phase One* includes data collection which includes the development of the initial project list. Projects were selected based on parameters established for the study. The selected projects were then screened based on the availability of data necessary to complete the study. For this study, the City of Moorhead, MN was selected for their acquisition (with Federal and State assistance) of 27 repetitive-loss properties. The final project list of these properties then proceeded to Phase 2: Data Analysis.

*Phase Two* includes multiple analyses of the data to determine if there were measurable avoided losses since the projects' completion. National Weather Service data was used to determine historical river crests of Red River since the properties were acquired. To calculate the flood losses avoided due to acquisition projects in the City of Moorhead, it was essential to obtain pre-mitigation data on each structure to be evaluated. This data included:

- Location
- Building Value
- Contents Value

This report contains project descriptive information and the impacts of those projects. Damage estimates were based on *actual* storm events and the potential losses that may have occurred had the mitigation project not taken place. FEMA's HAZUS –MH-MR4 modeling software was used to model a flood event and information from that model was applied to the five highest historical crests since the acquisitions were completed.

*Phase Three* involves the Loss Estimation Analysis. This analysis calculated the dollar amount from physical damage and loss of function from pre and post mitigation. Return on Investment (ROI) = Losses Avoided (LA) divided by Property Investment (PI) or acquisition cost x 100. The total losses avoided were estimated at \$9,443,150. The total project investment for the project was \$2,966,850. As a result, the collective return on investment for the five flood events was 318 percent.

Using the five storm events to determine possible damage that *would* have occurred to the properties had they not been acquired, yields significant returns on investments. The ROI will only increase as more flooding events occur, making property acquisition an effective and permanent mitigation tool.

## Section I: Introduction

Mitigation is any sustainable activity or project that reduces losses for people, property, or possessions. It is an activity that is practiced by local, state and federal entities and is one of FEMA’s primary missions. Working closely with partners at the state and local level, FEMA provides states and communities with substantial funds each year for mitigation activities that reduce or eliminate risk from natural hazards. The State of Minnesota has received millions of dollars in aid for mitigation activities.



The Red River in Moorhead, MN has suffered numerous major flooding events in recent years.

There are several mitigation measures that can be employed to circumvent the devastation of flood events. One in particular renders a permanent solution — acquisition. Property acquisition is one form of hazard mitigation. In a property acquisition project, the community buys private property, acquires its title, and then removes or relocates all structures on the land. By law, the land becomes public property and must forever remain open space. The community can use it to create public parks or wildlife refuges, but it can’t sell the property to private individuals or develop it. Property acquisitions work the same way as any other real estate transaction. Property owners who want to sell their property are given fair market value. It is a good opportunity for people who live in or near hazard areas to move to safer ground. The community also benefits by reducing the number of residents in danger during flooding.

### 1.1 Purpose

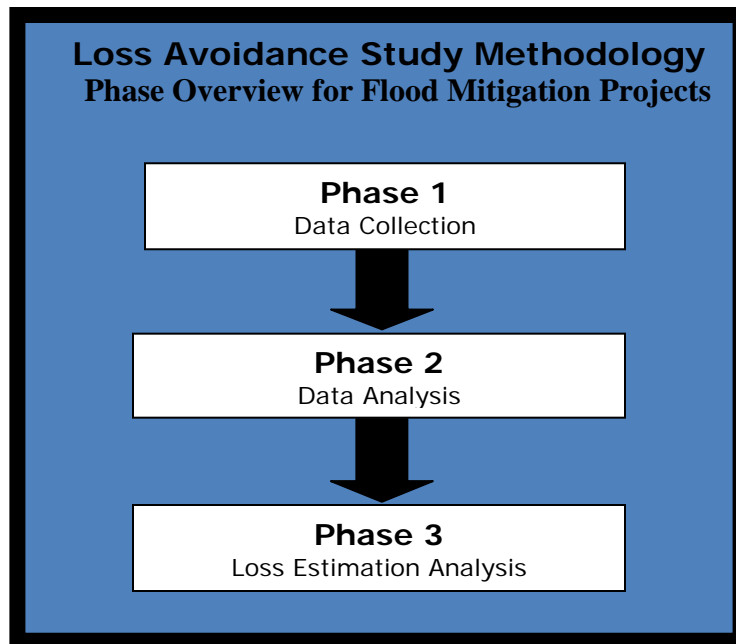
The State of Minnesota has invested millions of dollars to acquire flood-prone properties. How well is this mitigation initiative working? Can losses avoided be quantified as a direct result of implementing acquisition projects? This study seeks to provide the answers.

The scope of this study includes 27 acquisition properties in the City of Moorhead in Clay County, and funded through FEMA’s Hazard Mitigation Grant Program (HMGP). The study provides comprehensive documentation of “losses avoided” (damages avoided or benefits) utilizing quantitative methods. It also describes a reproducible and verifiable methodology so that results are meaningful and defensible.

## 1.2 Methodology Overview

This study focused on the performance of acquisition projects and was divided into three phases: **Phase 1: Data Collection**, **Phase 2: Data Analysis** and **Phase 3: Loss Estimation Analysis**.

Figure 1.2.1



**Phase 1: Data Collection** includes the development of the initial project list. Projects were selected based on parameters established for the study. The selected projects were evaluated based on the availability of data. The final project list then proceeded to Phase 2.

**Phase 2: Data Analysis** includes multiple analyses to determine if there were measurable avoided losses since the projects' completion. To calculate the flood losses avoided due to acquisition projects in the City of Moorhead, it was essential to obtain pre-mitigation data on each structure to be evaluated. These data include:

- Location
- Building Value
- Contents Value

**Phase 3: Loss Estimation Analysis** involves analyzing each project for flood damage loss. Loss Estimation Analysis is the final phase of a loss avoidance study. It is conducted to estimate the effectiveness of the mitigation project by calculating the avoided losses. The Loss Estimation Analysis calculates the cost of damage associated with the damage analysis conducted in Phase 2 of the study.



This phase includes two major tasks:

1. Calculating Losses Avoided (LA)

When calculating losses avoided (LA), the first step is to determine the dollar value estimate of the damage that *would* have occurred had the mitigation project not been executed.

2. Calculating Return On Investment (ROI)

In determining the Return on Investment (ROI), losses avoided (LA) and project investments (PI) or acquisition costs are used. The formula used to calculate ROI is shown below.

$$\frac{\$LA \text{ (Loss Avoided)}}{\$PI \text{ (Project Investment or Acquisition Cost)}} \times 100 = \mathbf{ROI}$$

## **Section 2: Project Selection**

### **2.1 Data Collection (Initial Project Selection)**

The first step is to determine the parameters of the study. These parameters may include hazard type, area of interest and project type.

#### *Hazard Type*

Projects may be chosen and screened based on hazard type. For this study, flooding is the hazard type.

#### *Area of Interest*

Depending on the study, the area of interest could vary from a community, a county, a region of a state, etc. The entity conducting the study should identify and define the area of interest prior to project selection. For this study, the City of Moorhead, Minnesota was chosen for its residential acquisitions.

#### *Project type*

Project selection may be based on project type. If flooding under study, the project type may be acquisitions, elevations or other mitigation projects. For this project, property acquisition is the project type.

### **2.2 Project Screening**

The initial list of projects must be evaluated to determine if enough specific data and characteristics are available for the methodology being applied. If the data are not available, the project should be removed from the list.

There are three primary considerations for the project screening process: initial site visits, local preferences, and available information.

#### *Initial Site Visit*

A site visit should be done in order to conduct a preliminary assessment of the project and meet the local officials that have worked with the project and have the most knowledge of it. Conducting the detailed data collection for Phase 2 and 3 can also be done at this time. The visit may reveal a lack of data necessary to complete the project or other resources that may be available.

### *Local Preferences*

FEMA works closely with state and local officials. These reports help inform local decision makers about the effectiveness of mitigation efforts they may be considering in their community. When developing these reports, the preferences of state and local officials is paramount as these reports are designed to inform their decision. To maximize their value, the local preferences are highly valued in project selection.

### *Available Information*

Some of the projects selected initially may not have enough information in project files to proceed. FEMA and other contracting agencies have had different long-term data storage requirements since mitigation programs began. Some of the basic information such as the original funding application and financial reports are usually kept in FEMA files. Some of the more detailed information including design drawings and digital data are often not in the same files. Therefore, the person conducting the study may be required to use other resources such as local governments or contracting consultants to retrieve the information. If adequate information cannot be found, the list of possible projects may be reduced.

## **2.3 Final Project Selection**

For this report, a listing of state projects was reviewed and the City of Moorhead was chosen. Moorhead has acquired a number of properties with FEMA mitigation funds over several years. Because the Moorhead area has been subject to repeated flooding, it is an ideal candidate for study. The repeated flooding provides several different events to evaluate the efficacy of mitigation efforts. Next, available information on the damage events since the buyout occurred, i.e. stream data/gauge information, National Climatic Data Center (NCDC) historical data, FEMA disaster declaration information, etc. was collected.

Moorhead was chosen based on the information that was available from local, state and FEMA offices. The final project list then proceeded to Phase 2, Data Analysis.

## **Section 3: Project Information**

This section of the report provides background information on the acquisition project for Moorhead, Minnesota. Information for this section comes from the FEMA project files, the National Weather Service and the Minnesota Department of Public Safety and Emergency Management.

Residents of the Red River valley are no stranger to flooding. Separated by the Red River, both Moorhead, Minnesota and Fargo, North Dakota have suffered a number of flooding events in recent years as the Red River crests and spills over its banks. Both communities have been very proactive in recent years in implementing urban flood control methods.

The community has worked closely with the State of Minnesota and FEMA to develop plans to reduce future flood damages. Central to these plans are the acquisition of properties in flood-prone areas. After Federal Disaster declaration DR-993 in 1993, community officials developed plans for property acquisition. Since that flood event, the City of Moorhead, working in close partnership with state and federal officials, has acquired numerous flood-prone properties and converted the land into open space.

This study focuses the acquisition of 27 residential properties in the City of Moorhead. All of these properties were classified as Repetitive-Loss Properties (RLP) and FEMA's Hazard Mitigation Grant Program (HMGP) funds were used to purchase them. The majority of the properties were acquired in 1995 and 1997, with the remaining four purchased in 2003, 2004, 2009 and 2010. The City of Moorhead and the State of Minnesota has acquired additional properties through other, non-FEMA funding sources. These properties are not being evaluated by this study. This study also does not consider property acquisitions in Fargo, North Dakota, where similar efforts have been undertaken to reduce future disaster losses.

### **3.1 History**

An unusual weather pattern in late summer of 1993 generated drenching rains in the Northern Mississippi River valley. With already saturated soil from a large snow pack the previous winter, and a very rainy April, conditions were ripe for a major flood. Over Mother's Day weekend, heavy rainfall caused flooding that continued through much of the summer, causing widespread flooding in Minnesota.

In 1997, heavy winter snow and ice accumulations and a rapid thaw in the spring resulted in catastrophic flooding of the Red River. The Red River crested at 39.5 feet, flooding homes and businesses in the community. Major flooding recurred in 2001, 2006, 2009 and 2010.

### 3.2 The Project (Moorhead acquisition)

#### Historic River Crest Data and Flood Impacts

Since the 1993 flooding, there have been five significant flooding events in the Moorhead area. These historic crest events are shown in Table 3.2.1. This data is from the USGS stream gauge located north of Gooseberry Mound Park. The expected local flood impacts are shown in Table 3.2.2.

<b>Table 3.2.1 Historical Crests for Red River at Moorhead</b>		
<b>Depth:</b>	<b>Date:</b>	<b>Flood Stage:</b>
39.57	April 17, 1997	Major
36.69	April 14, 2001	Major
37.13	April 5, 2006	Major
40.84	March 28, 2009	Major
36.96	March 21, 2010	Major

Source: National Weather Service

This report evaluates potential damages to acquired properties for these five flood events.

<b>Table 3.2.2 Flood Impacts in Moorhead, MN</b>	
<b>Crest -ft. (flood stages)</b>	<b>Impact:</b>
40' (Major)	Red River is lapping at the base of the Heritage Hjemkomst Interpretive Center.
35' (Major)	Actions taken to prevent storm sewers from backing up.
32.5' (Major)	Start diking to protect the Hjemkomst Center.
31' (Major)	1st Avenue North bridge is closed.
30' (Major)	Flood warning stage...major. 1st Avenue North underpass is closed.
28' (Moderate Stage)	15th Avenue North river bridge is closed.
25' (Moderate)	Flood warning stage...moderate. City Parks and Recreation areas along the river begin to flood.
18' (Flood warning stage)	Flood Warning Stage...minor.

Source: National Weather Service

Federal disaster aid provided to the state of Minnesota following flooding events includes a portion for disaster mitigation programs. These include programs designed to reduce or eliminate the impact of future events and may include programs such as flood proofing or acquisition.

Mitigation projects are driven by local preferences. FEMA partners with state and local officials to assist with project development and technical details. The City of Moorhead has developed a number of mitigation projects including property acquisition and applied for federal funding. FEMA awarded Moorhead's acquisition projects and assisted the community with implementation.

Figure 3.2.1 Acquisition Area and USGS Stream Gauge location

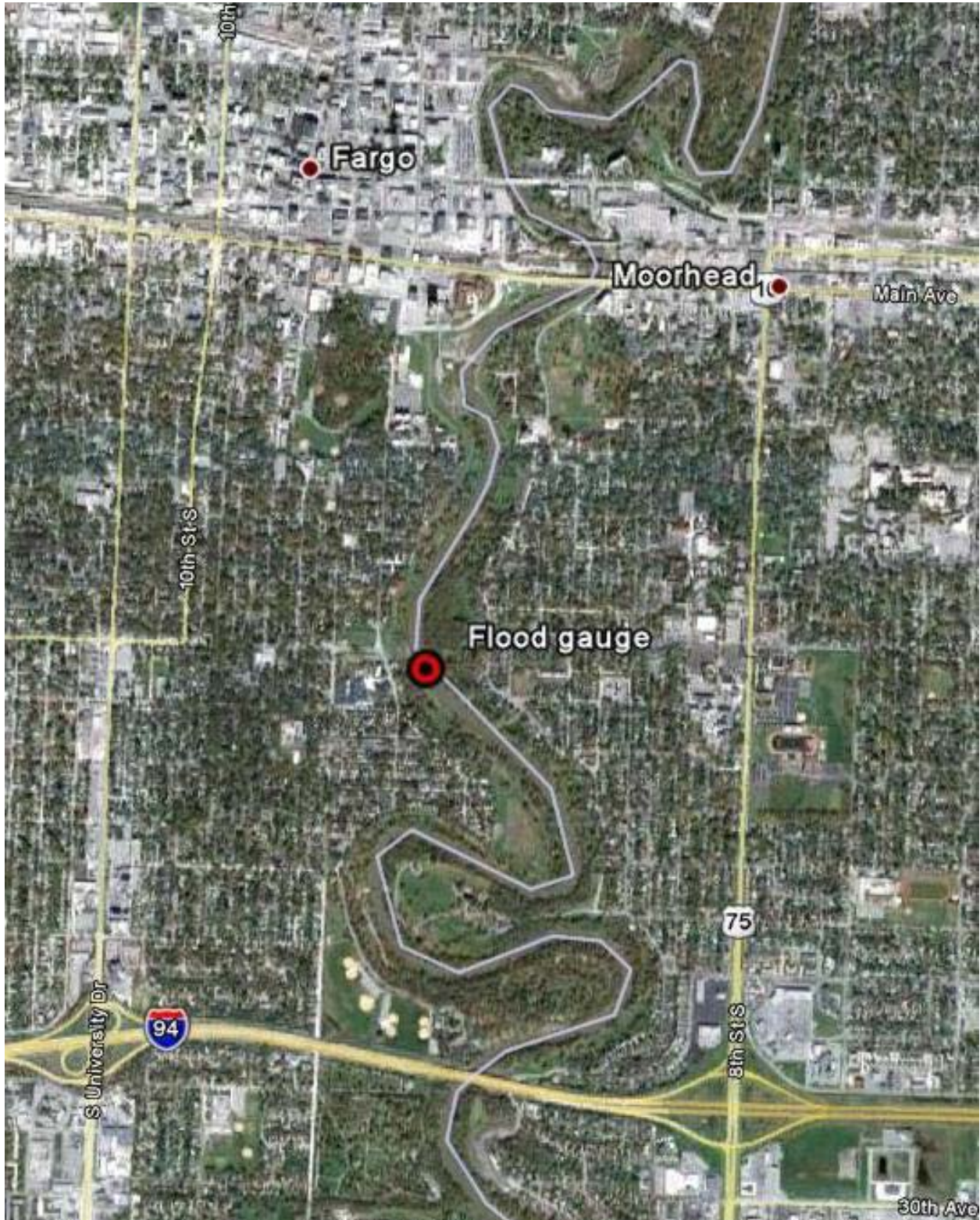
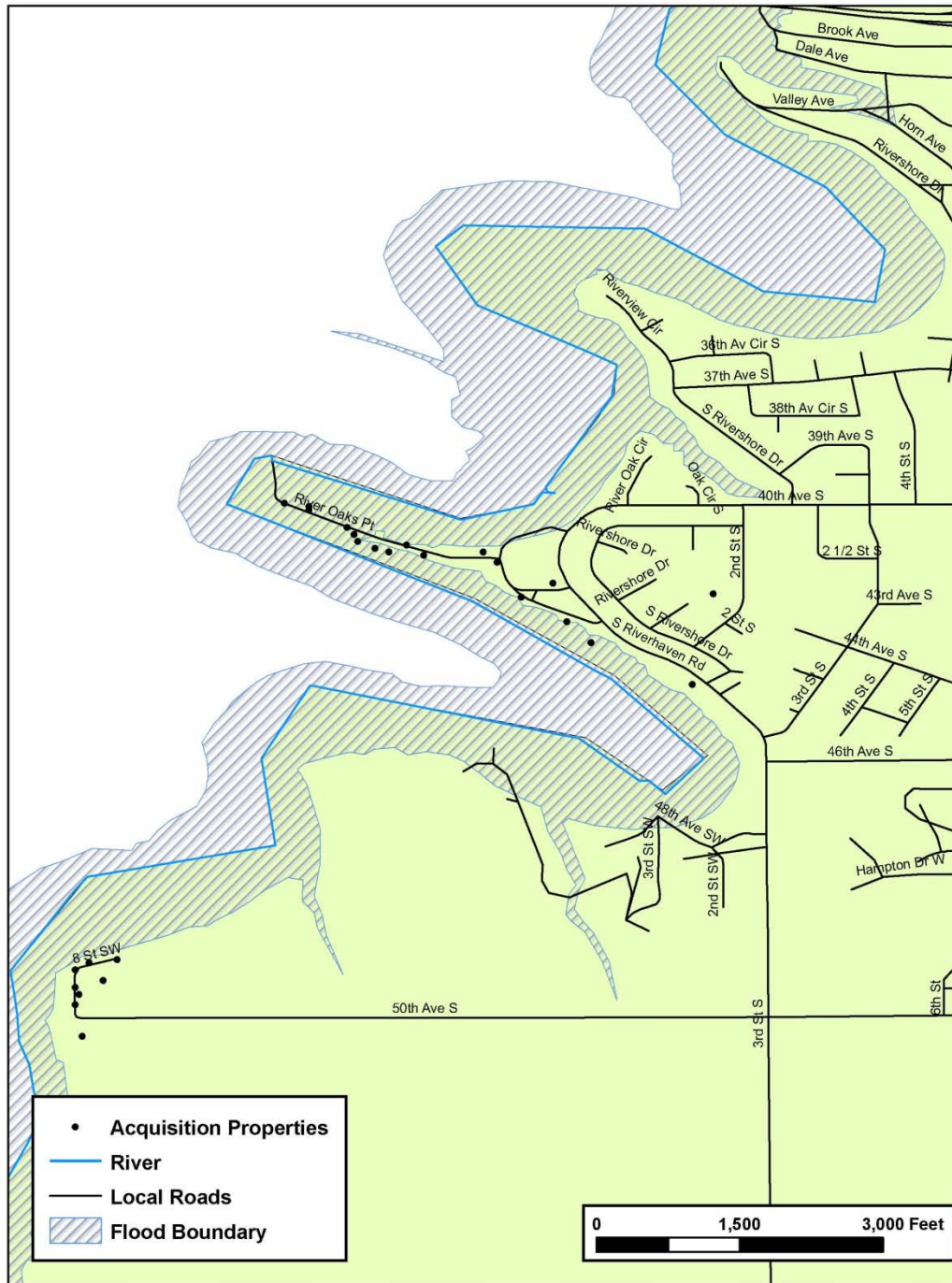


Figure 3.2.2 Acquisition Properties in the Floodplain in Moorhead, MN



HAZUS-MH MR4 modeling was utilized to estimate potential damages to the acquisition properties involved in Moorhead. This methodology offers the most reasonable solution to accomplish loss estimation primarily because data from other sources such as benefit cost analysis (BCA) worksheets was not available. We can determine potential damage percentages to buildings by utilizing the capability of HAZUS to estimate losses based on the property’s geographic location in relation to the floodplain and the depth of the flood water. Applying these percentages to the values assigned to the structure and contents provide an estimate of potential losses avoided.

The values represented in Table 3.2.3 will be used to calculate losses avoided for potential flooding events based on the top five historical crests as detailed in Table 3.2.1. HAZUS modeling was completed for *each* of the five flood event dates used in this report.

<b>Table 3.2.3 Acquisition Properties - Addresses and Values (Moorhead, MN)</b>			
<b>Property Address</b>	<b>Building Value</b>	<b>Content Value</b>	<b>Total Value</b>
23 River Oaks Point	\$112,500	\$56,250	\$168,750
65 River Oaks Point	\$125,000	\$62,500	\$187,500
27 River Oaks Point	\$115,000	\$57,500	\$172,500
15 River Oaks Point	\$162,000	\$81,000	\$243,000
4221 River Haven Road	\$55,000	\$27,500	\$82,500
73 River Oaks Point	\$133,000	\$66,500	\$199,500
45 River Oaks Point	\$128,500	\$64,250	\$192,750
44 Rivers Oaks Point	\$132,000	\$66,000	\$198,000
711 18th Avenue North	\$192,500	\$96,250	\$288,750
809 9th Avenue North	\$34,000	\$17,000	\$51,000
733 9th Street North	\$45,000	\$22,500	\$67,500
1415 River Drive South	\$124,000	\$62,000	\$186,000
305 Elm Street South	\$25,500	\$12,750	\$38,250
409 Elm Street South	\$22,500	\$11,250	\$33,750
14 7th Avenue South	\$42,000	\$21,000	\$63,000
615 Elm Street South	\$55,000	\$27,500	\$82,500
24 River Oaks Point	\$103,000	\$51,500	\$154,500
49 River Oaks Point	\$124,000	\$62,000	\$186,000
61 River Oaks Point	\$113,691	\$56,846	\$170,537
57 River Oaks Point	\$122,700	\$61,350	\$184,050
31 River Oaks Point	\$124,600	\$62,300	\$186,900
19 River Oaks Point	\$128,600	\$64,300	\$192,900
4211 River Haven Road	\$123,000	\$61,500	\$184,500
609 Elm Street South	\$59,550	\$29,775	\$89,325
605 9th Street North	\$88,300	\$44,150	\$132,450
11 River Oaks Point	\$247,500	\$123,750	\$371,250
40 River Oaks Point	\$298,500	\$149,250	\$447,750

Source: State of Minnesota and the City of Moorhead



The 27 properties involved in the acquisition project were in the floodway of the Red River. Data necessary for the analysis of the 27 properties was obtained from the State of Minnesota Department of Homeland Security and Emergency Management Agency and the City of Moorhead.

Table 3.2.4 represents the cumulative damage and projected return on investment results for all five flood events for properties involved in the acquisition project. Additional costs such as displacement and disruption have not been calculated or applied in the analysis.

<b>Table 3.2.4 Mitigation Investment and Loss Estimation by Event</b>							
<b>Analysis Information</b>			<b>Estimated Losses Avoided</b>				
Event Date	Buildings Included in Analysis	Buildings With Potential Losses Avoided	Building Damage	Content Damage	Total Loss Avoided	Project Investment	Projected ROI
April 17, 1997	8	6	\$437,700	\$246,279	\$683,979	\$963,000	71%
April 14, 2001	23	15	\$1,161,289	\$650,728	\$1,812,017	\$2,273,000	80%
April 5, 2006	25	15	\$1,321,942	\$740,750	\$2,062,692	\$2,420,850	85%
March 28, 2009	26	16	\$1,523,098	\$862,535	\$2,385,633	\$2,668,350	89%
March 21, 2010	27	16	\$1,601,580	\$897,249	\$2,498,829	\$2,966,850	84%

Source: Minnesota Loss Avoidance Study - 2010

The following tables (Table 3.2.5 thru Table 3.2.9) show loss estimation for each historical crest represented in Table 3.2.1, beginning with the highest historical crest (40.84’ on March 29, 2009) to the lowest (36.69’ on April 14, 2001). All of the properties had completed the acquisition process and are included for each event. Not every property was assumed to have property damage based on the HAZUS-MH MR4 modeling of the actual river crest levels from the top five flood events. The properties highlighted in each table had *possible* damage for that particular flood stage on the event date and those figures are included for Total Losses Avoided (LA) and eventually in the Return on Investment (ROI) figures later in the report. As one would expect, as the historic river crest becomes lower, fewer properties are affected and lower damage amounts are noted.

<b>Table 3.2.5 March 29, 2009 Flood Event (River Crest 40.84 ft.)</b>								
<b>Street</b>	<b>Building Value</b>	<b>Content Value</b>	<b>HAZUS Building Damage %</b>	<b>HAZUS Contents Damage %</b>	<b>Building Damage Amount</b>	<b>Content Damage Amount</b>	<b>Total Losses Avoided</b>	<b>Project Investment</b>
23 River Oaks Point	\$158,369	\$79,184	54%	60%	\$85,519	\$47,511	\$133,030	\$112,500
65 River Oaks Point	\$175,965	\$87,983	54%	60%	\$95,021	\$52,790	\$147,811	\$125,000
27 River Oaks Point	\$161,888	\$80,944	54%	60%	\$87,420	\$48,566	\$135,986	\$115,000
15 River Oaks Point	\$228,051	\$114,026	54%	60%	\$123,148	\$68,415	\$191,563	\$162,000
4221 River Haven Road	\$77,425	\$38,712	0%	0%	\$0	\$0	\$0	\$55,000
73 River Oaks Point	\$187,227	\$93,614	50%	60%	\$93,614	\$56,168	\$149,782	\$133,000
45 River Oaks Point	\$180,892	\$90,446	0%	0%	\$0	\$0	\$0	\$128,500
44 Rivers Oaks Point	\$185,819	\$92,910	54%	60%	\$100,343	\$55,746	\$156,088	\$132,000
711 18th Avenue North	\$257,311	\$128,655	54%	60%	\$138,948	\$77,193	\$216,141	\$192,500
809 9th Avenue North	\$45,447	\$22,724	54%	45%	\$24,541	\$10,239	\$34,781	\$34,000
733 9th Street North	\$60,151	\$30,075	0%	0%	\$0	\$0	\$0	\$43,500
1415 River Drive South	\$165,748	\$82,874	54%	60%	\$89,504	\$49,724	\$139,228	\$124,000
305 Elm Street South	\$34,085	\$17,043	44%	57%	\$14,998	\$9,714	\$24,712	\$25,500
409 Elm Street South	\$30,075	\$15,038	0%	0%	\$0	\$0	\$0	\$22,500
14 7th Avenue South	\$56,141	\$28,070	54%	60%	\$30,316	\$16,842	\$47,158	\$37,000
615 Elm Street South	\$73,517	\$36,759	0%	0%	\$0	\$0	\$0	\$55,000
24 River Oaks Point	\$137,678	\$68,839	0%	0%	\$0	\$0	\$0	\$103,000
49 River Oaks Point	\$165,748	\$82,874	50%	60%	\$82,874	\$49,724	\$132,599	\$114,000
61 River Oaks Point	\$151,968	\$75,984	54%	60%	\$82,063	\$45,591	\$127,653	\$111,000
57 River Oaks Point	\$164,011	\$82,005	54%	60%	\$88,566	\$49,203	\$137,769	\$114,000
31 River Oaks Point	\$166,550	\$83,275	54%	60%	\$89,937	\$49,965	\$139,902	\$111,000
19 River Oaks Point	\$171,897	\$85,948	54%	60%	\$92,824	\$51,569	\$144,393	\$113,000

<b>Table 3.2.5 March 29, 2009 Flood Event (River Crest 40.84 ft.)</b>								
<b>Street</b>	<b>Building Value</b>	<b>Content Value</b>	<b>HAZUS Building Damage %</b>	<b>HAZUS Contents Damage %</b>	<b>Building Damage Amount</b>	<b>Content Damage Amount</b>	<b>Total Losses Avoided</b>	<b>Project Investment</b>
4211 River Haven Road	\$164,412	\$82,206	53%	60%	\$87,138	\$49,323	\$136,462	\$110,000
609 Elm Street South	\$69,433	\$34,717	0%	0%	\$0	\$0	\$0	\$59,550
605 9th Street North	\$100,284	\$50,142	0%	0%	\$0	\$0	\$0	\$88,300
11 River Oaks Point	\$247,500	\$123,750	47%	60%	\$116,325	\$74,250	\$190,575	\$247,500

Source: FEMA- HAZUS-MH MR4 Modeling

HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties.

All values have been adjusted for inflation

<b>Table 3.2.6 April 17, 1997 Flood Event (River Crest 39.57 ft.)</b>								
<b>Street</b>	<b>Building Value</b>	<b>Content Value</b>	<b>HAZUS Building Damage %</b>	<b>HAZUS Contents Damage %</b>	<b>Building Damage Amount</b>	<b>Content Damage Amount</b>	<b>Total Losses Avoided</b>	<b>Project Investment</b>
23 River Oaks Point	\$118,479	\$59,240	54%	60%	\$63,979	\$35,544	\$99,523	\$112,500
65 River Oaks Point	\$131,644	\$65,822	54%	60%	\$71,088	\$39,493	\$110,581	\$125,000
27 River Oaks Point	\$121,112	\$60,556	54%	60%	\$65,401	\$36,334	\$101,734	\$115,000
15 River Oaks Point	\$170,610	\$85,305	54%	60%	\$92,130	\$51,183	\$143,313	\$162,000
4221 River Haven Road	\$57,923	\$28,962	0%	0%	\$0	\$0	\$0	\$55,000
73 River Oaks Point	\$140,069	\$70,034	50%	60%	\$70,034	\$42,021	\$112,055	\$133,000
45 River Oaks Point	\$135,330	\$67,665	0%	0%	\$0	\$0	\$0	\$128,500
44 Rivers Oaks Point	\$139,016	\$69,508	54%	60%	\$75,069	\$41,705	\$116,773	\$132,000

Source: FEMA- HAZUS-MH MR4 Modeling

HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties.

All values have been adjusted for inflation

**Table 3.2.7 April 5, 2006 Flood Event (River Crest 37.13 ft.)**

Street	Building Value	Content Value	HAZUS Building Damage %	HAZUS Contents Damage %	Building Damage Amount	Content Damage Amount	Total Losses Avoided	Project Investment
23 River Oaks Point	\$148,819	\$74,409	54%	60%	\$80,362	\$44,646	\$125,008	\$112,500
65 River Oaks Point	\$165,354	\$82,677	54%	60%	\$89,291	\$49,606	\$138,898	\$125,000
27 River Oaks Point	\$152,126	\$76,063	54%	60%	\$82,148	\$45,638	\$127,786	\$115,000
15 River Oaks Point	\$214,299	\$107,150	54%	60%	\$115,722	\$64,290	\$180,011	\$162,000
4221 River Haven Road	\$72,756	\$36,378	0%	0%	\$0	\$0	\$0	\$55,000
73 River Oaks Point	\$175,937	\$87,969	50%	60%	\$87,969	\$52,781	\$140,750	\$133,000
45 River Oaks Point	\$169,984	\$84,992	0%	0%	\$0	\$0	\$0	\$128,500
44 Rivers Oaks Point	\$174,614	\$87,307	54%	60%	\$94,292	\$52,384	\$146,676	\$132,000
711 18th Avenue North	\$241,794	\$120,897	54%	60%	\$130,569	\$72,538	\$203,107	\$192,500
809 9th Avenue North	\$42,707	\$21,353	54%	45%	\$23,062	\$9,622	\$32,683	\$34,000
733 9th Street North	\$56,523	\$28,262	0%	0%	\$0	\$0	\$0	\$43,500
1415 River Drive South	\$155,753	\$77,877	54%	60%	\$84,107	\$46,726	\$130,833	\$124,000
305 Elm Street South	\$32,030	\$16,015	44%	57%	\$14,093	\$9,129	\$23,222	\$25,500
409 Elm Street South	\$28,262	\$14,131	0%	0%	\$0	\$0	\$0	\$22,500
14 7th Avenue South	\$52,755	\$26,378	54%	60%	\$28,488	\$15,827	\$44,314	\$37,000
615 Elm Street South	\$69,084	\$34,542	0%	0%	\$0	\$0	\$0	\$55,000
24 River Oaks Point	\$129,376	\$64,688	0%	0%	\$0	\$0	\$0	\$103,000
49 River Oaks Point	\$155,753	\$77,877	50%	60%	\$77,877	\$46,726	\$124,603	\$114,000
61 River Oaks Point	\$142,804	\$71,402	54%	60%	\$77,114	\$42,841	\$119,956	\$111,000
57 River Oaks Point	\$154,120	\$77,060	54%	60%	\$83,225	\$46,236	\$129,461	\$114,000
31 River Oaks Point	\$156,507	\$78,253	54%	60%	\$84,514	\$46,952	\$131,466	\$111,000
19 River Oaks Point	\$161,531	\$80,766	54%	60%	\$87,227	\$48,459	\$135,686	\$113,000
4211 River Haven Road	\$154,497	\$77,249	53%	60%	\$81,884	\$46,349	\$128,233	\$110,000
609 Elm Street South	\$65,246	\$32,623	0%	0%	\$0	\$0	\$0	\$59,550
605 9th Street North	\$94,237	\$47,118	0%	0%	\$0	\$0	\$0	\$88,300

Source: FEMA- HAZUS-MH MR4 Modeling

HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties.

All values have been adjusted for inflation

Table 3.2.8 March 21, 2010 Flood Event (River Crest 36.96 ft.)								
Street	Building Value	Content Value	HAZUS Building Damage %	HAZUS Contents Damage %	Building Damage Amount	Content Damage Amount	Total Losses Avoided	Project Investment
23 River Oaks Point	\$160,632	\$80,316	54%	60%	\$86,741	\$48,190	\$134,931	\$112,500
65 River Oaks Point	\$178,480	\$89,240	54%	60%	\$96,379	\$53,544	\$149,923	\$125,000
27 River Oaks Point	\$164,202	\$82,101	54%	60%	\$88,669	\$49,261	\$137,929	\$115,000
15 River Oaks Point	\$231,310	\$115,655	54%	60%	\$124,908	\$69,393	\$194,301	\$162,000
4221 River Haven Road	\$78,531	\$39,266	0%	0%	\$0	\$0	\$0	\$55,000
73 River Oaks Point	\$189,903	\$94,951	50%	60%	\$94,951	\$56,971	\$151,922	\$133,000
45 River Oaks Point	\$183,478	\$91,739	0%	0%	\$0	\$0	\$0	\$128,500
44 Rivers Oaks Point	\$188,475	\$94,238	54%	60%	\$101,777	\$56,543	\$158,319	\$132,000
711 18th Avenue North	\$260,988	\$130,494	54%	60%	\$140,934	\$78,296	\$219,230	\$192,500
809 9th Avenue North	\$46,097	\$23,048	54%	45%	\$24,892	\$10,386	\$35,278	\$34,000
733 9th Street North	\$61,010	\$30,505	0%	0%	\$0	\$0	\$0	\$43,500
1415 River Drive South	\$168,117	\$84,058	54%	60%	\$90,783	\$50,435	\$141,218	\$124,000
305 Elm Street South	\$34,572	\$17,286	44%	57%	\$15,212	\$9,853	\$25,065	\$25,500
409 Elm Street South	\$30,505	\$15,253	0%	0%	\$0	\$0	\$0	\$22,500
14 7th Avenue South	\$56,943	\$28,471	54%	60%	\$30,749	\$17,083	\$47,832	\$37,000
615 Elm Street South	\$74,568	\$37,284	0%	0%	\$0	\$0	\$0	\$55,000
24 River Oaks Point	\$139,646	\$69,823	0%	0%	\$0	\$0	\$0	\$103,000
49 River Oaks Point	\$168,117	\$84,058	50%	60%	\$84,058	\$50,435	\$134,494	\$114,000
61 River Oaks Point	\$154,140	\$77,070	54%	60%	\$83,236	\$46,242	\$129,478	\$111,000
57 River Oaks Point	\$166,354	\$83,177	54%	60%	\$89,831	\$49,906	\$139,738	\$114,000
31 River Oaks Point	\$168,930	\$84,465	54%	60%	\$91,222	\$50,679	\$141,902	\$111,000
19 River Oaks Point	\$174,354	\$87,177	54%	60%	\$94,151	\$52,306	\$146,457	\$113,000
4211 River Haven Road	\$166,761	\$83,381	53%	60%	\$88,383	\$50,028	\$138,412	\$110,000
609 Elm Street South	\$70,425	\$35,213	0%	0%	\$0	\$0	\$0	\$59,550
605 9th Street North	\$101,717	\$50,859	0%	0%	\$0	\$0	\$0	\$88,300
11 River Oaks Point	\$251,037	\$125,519	47%	60%	\$117,987	\$75,311	\$193,299	\$247,500
40 River Oaks Point	\$298,500	\$149,250	19%	15%	\$56,715	\$22,388	\$79,103	\$298,500

Source: FEMA- HAZUS-MH MR4 Modeling  
 HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties.  
 All values have been adjusted for inflation

<b>Table 3.2.9 April 14, 2001 Flood Event (River Crest 36.69 ft.)</b>								
<b>Street</b>	<b>Building Value</b>	<b>Content Value</b>	<b>HAZUS Building Damage %</b>	<b>HAZUS Contents Damage %</b>	<b>Building Damage Amount</b>	<b>Content Damage Amount</b>	<b>Total Losses Avoided</b>	<b>Project Investment</b>
23 River Oaks Point	\$130,733	\$65,367	54%	60%	\$70,596	\$39,220	\$109,816	\$112,500
65 River Oaks Point	\$145,259	\$72,630	54%	60%	\$78,440	\$43,578	\$122,018	\$125,000
27 River Oaks Point	\$133,638	\$66,819	54%	60%	\$72,165	\$40,092	\$112,256	\$115,000
15 River Oaks Point	\$188,256	\$94,128	54%	60%	\$101,658	\$56,477	\$158,135	\$162,000
4221 River Haven Road	\$63,914	\$31,957	0%	0%	\$0	\$0	\$0	\$55,000
73 River Oaks Point	\$154,556	\$77,278	50%	60%	\$77,278	\$46,367	\$123,645	\$133,000
45 River Oaks Point	\$149,326	\$74,663	0%	0%	\$0	\$0	\$0	\$128,500
44 Rivers Oaks Point	\$153,394	\$76,697	54%	60%	\$82,833	\$46,018	\$128,851	\$132,000
711 18th Avenue North	\$212,410	\$106,205	54%	60%	\$114,701	\$63,723	\$178,424	\$192,500
809 9th Avenue North	\$37,517	\$18,758	54%	45%	\$20,259	\$8,452	\$28,711	\$34,000
733 9th Street North	\$49,654	\$24,827	0%	0%	\$0	\$0	\$0	\$43,500
1415 River Drive South	\$136,825	\$68,412	54%	60%	\$73,885	\$41,047	\$114,933	\$124,000
305 Elm Street South	\$28,137	\$14,069	44%	57%	\$12,380	\$8,019	\$20,400	\$25,500
409 Elm Street South	\$24,827	\$12,414	0%	0%	\$0	\$0	\$0	\$22,500
14 7th Avenue South	\$46,344	\$23,172	54%	60%	\$25,026	\$13,903	\$38,929	\$37,000
615 Elm Street South	\$60,688	\$30,344	0%	0%	\$0	\$0	\$0	\$55,000
24 River Oaks Point	\$113,653	\$56,826	0%	0%	\$0	\$0	\$0	\$103,000
49 River Oaks Point	\$136,825	\$68,412	50%	60%	\$68,412	\$41,047	\$109,460	\$114,000
61 River Oaks Point	\$125,450	\$62,725	54%	60%	\$67,743	\$37,635	\$105,378	\$111,000
57 River Oaks Point	\$135,390	\$67,695	54%	60%	\$73,111	\$40,617	\$113,728	\$114,000
31 River Oaks Point	\$137,487	\$68,743	54%	60%	\$74,243	\$41,246	\$115,489	\$111,000
19 River Oaks Point	\$141,901	\$70,950	54%	60%	\$76,626	\$42,570	\$119,197	\$113,000
4211 River Haven Road	\$135,721	\$67,861	53%	60%	\$71,932	\$40,716	\$112,649	\$110,000

Source: FEMA- HAZUS-MH MR4 Modeling

HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties.

All values have been adjusted for inflation

Table 3.2.10 represents potential return on investment based on the cumulative results of the damage estimates for each event.

<b>Table 3.2.10 Cumulative Results Through 5 Events</b>			
<b>Street</b>	<b>Total Losses Avoided</b>	<b>Project Investment</b>	<b>ROI</b>
23 River Oaks Point	\$602,307	\$112,500	535%
65 River Oaks Point	\$669,230	\$125,000	535%
27 River Oaks Point	\$615,692	\$115,000	535%
15 River Oaks Point	\$867,322	\$162,000	535%
4221 River Haven Road	\$0	\$55,000	0%
73 River Oaks Point	\$678,153	\$133,000	510%
45 River Oaks Point	\$0	\$128,500	0%
44 Rivers Oaks Point	\$706,707	\$132,000	535%
711 18th Avenue North	\$816,902	\$192,500	424%
809 9th Avenue North	\$131,453	\$34,000	387%
733 9th Street North	\$0	\$43,500	0%
1415 River Drive South	\$526,212	\$124,000	424%
305 Elm Street South	\$93,398	\$25,500	366%
409 Elm Street South	\$0	\$22,500	0%
14 7th Avenue South	\$178,233	\$37,000	482%
615 Elm Street South	\$0	\$55,000	0%
24 River Oaks Point	\$0	\$103,000	0%
49 River Oaks Point	\$501,155	\$114,000	440%
61 River Oaks Point	\$482,465	\$111,000	435%
57 River Oaks Point	\$520,696	\$114,000	457%
31 River Oaks Point	\$528,759	\$111,000	476%
19 River Oaks Point	\$545,733	\$113,000	483%
4211 River Haven Road	\$515,755	\$110,000	469%
609 Elm Street South	\$0	\$59,550	0%
605 9th Street North	\$0	\$88,300	0%
11 River Oaks Point	\$383,874	\$247,500	155%
40 River Oaks Point	\$79,103	\$298,500	27%
<b>Totals</b>	<b>\$9,443,150</b>	<b>\$2,966,850</b>	<b>318%</b>

Property Information Source: State of Minnesota; City of Moorhead, MN  
 HAZUS-MH MR4 Data Source: FEMA HAZUS-MH MR4 100 Year Flood Model for identified properties  
 All values have been adjusted for inflation

Return on investment was calculated using the following formula:

**Return on Investment (ROI)**

$$\frac{\$9,442,150 \quad \$LA \text{ (Loss Avoided)}}{\$2,966,850 \quad \$PI \text{ (Project Investment)}} \times 100 = 318\% \text{ (ROI)}$$



*Data Shortfalls:*

For all acquisition projects identifying the correct elevations, (first floor, base flood, and event elevations) is a critical concern. For the Moorhead acquisition project these data were not available in their entirety. While the actual river elevation was established through the use of river gauge data, the first floor elevations were not available. As well, these could not be determined after the fact since the properties were removed after acquisition. Base flood elevations were established using HAZUS modeling and the flood boundaries obtained through the FEMA Map Service Center. It is important to understand however that HAZUS is a modeling tool and results generated in HAZUS are projections using best information available.

*Conclusion:*

In reviewing the HAZUS data for the five flood events, the resulting potential for losses avoided is significant. When viewed in the context of *when* the next event does happen, there is no question that there will be significant losses avoided as a result of this acquisition project. And, as time goes by, the return on investment will only continue to grow with each future damage event.

It is clear that the most effective mitigation programs are those that remove properties from the flood plain. These projects in the City of Moorhead demonstrate numerous positive outcomes. The affected residents in the community no longer suffer flooding in their homes, and for Clay County and the State of Minnesota, acquisition projects prove to be extremely cost effective over the lifetime of the project.

## Section 4: Loss Estimation Analysis

The Loss Estimation Analysis is the final phase of a loss avoidance study. This is conducted to estimate the avoided losses based on the effectiveness of the mitigation project during the storm event of interest. The Loss Estimation Analysis is accomplished by calculating the damage (in dollars) associated with the damage analysis reported in Section Two. This section briefly reviews the procedures used in determining the success of the mitigation effort set forth in this study. It includes two major tasks:

- (1) Calculating Losses Avoided (LA)
- (2) Calculating Return On Investment (ROI)

### Calculating Losses Avoided

The losses avoided analysis determines the dollar value estimate of the damage that *may* have occurred had the mitigation project not been executed and the damage that *could* occur after the project was executed. The losses avoided (in dollars) were calculated by subtracting the mitigation completed from the estimated mitigation, absent damages. The end result of the loss calculation was an estimated loss value for the event that actually occurred. The losses were calculated in present-day values.

### Calculating Return on Investment

The final task in determining losses avoided is to calculate the ROI. The methodology and results may vary depending upon the number of events being analyzed for each mitigation project and the level of damage sustained during each impacting event.

The Project Investment (PI) represents total project investment for the mitigation projects being evaluated. Project investment captures the resource investment from all parties including state, county and community, and not simply the federal contribution. It does not include work conducted outside of the mitigation projects. The upper portion of the equation (LA) is the total losses avoided. Multiple events are being evaluated for each mitigation project. The LA represents the total losses for all the storm events evaluated. Therefore, the ROI represents the return on investment for the project over five storm events.

Table 4.1 illustrates the Return on Investment for all of the mitigation acquisition projects over the five historic flood events.

<b>Table 4.1 Return on Mitigation Investment</b>			
<b>Project:</b>	<b>Losses Avoided :</b>	<b>Project Investment:</b>	<b>Return on Investment:</b>
<b>City of Moorhead acquisitions (27)</b>	<b>\$9,443,150</b>	<b>\$2,966,850</b>	<b>318%</b>

The cumulative ROI for all of the Moorhead acquisition properties (27) over five historic flood stage events is estimated to be 318%. As major flood events occur in the future, the return on investment will continue to increase. The costs to the City of Moorhead for emergency response will continue to decrease as more successful mitigation projects are completed and tested by major flood events.

## **Section 5: Summary**

The City of Moorhead has successfully mitigated 27 properties in the area.

This type of mitigation (acquisition) is necessary or the owners of these properties will continue to be at risk in future flooding events. While property or contents may not always be at risk during future floods, people will be stranded in their properties if they do not evacuate. The community will need to continue emergency services to this area during flood events putting community resources (personnel and property) at risk.

The City of Moorhead, Clay County, the State of Minnesota, and the Federal Emergency Management Agency all invested significant time and money to acquire and remove at-risk homes from the floodplain. This study demonstrates the fruits of those efforts.

In less than 15 years since the acquisitions began, Moorhead has suffered five significant flooding events. These events would have caused nearly \$10 million in damage to the properties that were removed, a tremendous return on an investment of less than \$3 million. This return will only continue to increase as Moorhead remains susceptible to future flooding. Fortunately, because of a strong partnership between local, state and federal officials, at least 27 more homes will no longer suffer the devastation of a flood.