Papio-Missouri River Natural Resources District

All-Hazards Mitigation Plan

Completed by
Nebraska Department of Natural Resources
U.S. Army Corps of Engineers

September 2006

U.S. Department of Homeland Security
Region VII
9221 Ward Parkway, Suite 300
Kansas City, MO 64114-3372

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DEPARTMENT OF NATURAL RESOURCES

Al Berndt
Assistant Director
Nebraska Emergency Management Agency
1300 Military Road
Lincoln, Nebraska 68508

Subject: Review of the Papio-Missouri River NRD Plan, Local Multi-Hazard Mitigation Plan

Dear Mr. Berndt:

The purpose of this letter is to provide the status of the above referenced Local Hazard Mitigation Plan, pursuant to the requirements of 44 CFR Part 201 - Mitigation Planning and Part 78 - FMA Planning & the Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000, dated March 2004.

All requests for funding will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted. For example, a specific mitigation activity or project identified in the plan may not meet the eligibility requirements for FEMA funding, and even eligible mitigation activities are not automatically approved for FEMA funding under any of the aforementioned program.

The Regional Office staff have reviewed the plan and provided the following comments.

Local Jurisdiction	Date Adoptions Submitted	Date Completed	Plan Review Type	Review Status	Date Final Approval
Papio-Missouri River NRD	September 28, 2006	September 28, 2006	☒ DMA2K	Approved	September 28, 2006
			☒ FMA	Approved	September 28, 2006

Enclosed for your use is a copy of the above sited Local Mitigation Plan Review and Evaluation Check-list.

If you have any questions or concerns, please contact Jim Donley, Senior Community Mitigation Program Specialist at (816) 283-7010.

Sincerely

Robert G. Bissell, Director
Federal Insurance & Mitigation Division

Enclosure:

Concurrence:

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Chapter 1 – Introduction

I. Purpose of this Plan

The purpose of this plan is to fulfill local multi-jurisdictional Hazard Mitigation Plan requirements. The plan will identify hazards, establish community goals and objectives, and select mitigation activities that are appropriate for the Papio-Missouri River Natural Resources District (Papio NRD).

The Disaster Mitigation Act of 2000 (DMA2000), Section 322 (a-d) requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process of identifying hazards, risks and vulnerabilities, identify and prioritize mitigation actions, encourage the development of local mitigation, and provide technical support for those efforts.

In addition, this plan has fulfilled the requirements of the National Flood Insurance Reform Act of 1994 (NFIRA). With this Act, Congress authorized the establishment of a Federal grant program to provide financial assistance to States and communities for flood mitigation planning and activities. The Federal Emergency Management Agency (FEMA) has designated this the Flood Mitigation Assistance (FMA) program.

Under the FMA program, FEMA provides assistance to States and communities for activities that will reduce the risk of flood damages to structures insurance under the National Flood Insurance Program (NFIP). FMA is a state-administered cost-share program through which states and communities can receive grants for flood mitigation planning, technical assistance, and mitigation projects.

Only projects for mitigation activities specified in an approved Flood Mitigation Plan are eligible for FMA project grants. These activities include elevation, acquisition, and relocation of flood-prone insurable structures.

The purpose of this plan is to produce a program of activities that will best tackle the Papio NRD's hazard and flood problems and meet other, community-specific needs. Consistent with FEMA planning process guidelines, the purpose of this plan is to accomplish the following objectives:

- Ensure that all possible activities are reviewed and implemented so that disaster related hazards are addressed by the most appropriate and efficient solution;
- Link hazard management policies to specific activities;
- Educate residents about potential hazards that threaten the community, including but not limited to floods, extreme weather events, tornadoes and high wind events, earthquakes, and human-made events;
- Build public and political support for projects that prevent new problems from known hazards and reduce future losses;
- Fulfill planning requirements for future hazard mitigation project grants, and;
- Facilitate implementation of hazard mitigation management activities through an action plan.

II. Methodology

The methodology used for the development and updating of the Papio NRD Hazard Mitigation Plan, consisted of the following tasks:

1. Public Involvement
2. Coordination with other agencies or organizations
3. Hazard area inventory
4. Problem identification
5. Review and analysis of possible mitigation activities
6. Local adoption following a public hearing
7. Periodic review and update

This hazard mitigation plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of the hazards to which Papio NRD residents deemed they were most vulnerable, and recommends mitigation solutions.

The Mitigation Plan will be evaluated and updated every five years. In addition, the plan will be updated as appropriate when a disaster occurs that significantly affects the NRD, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date of the disaster event.

Routine maintenance of the plan will include adding projects as new funding sources become available, or removing projects as they are completed.

<u>People involved in the planning process</u>:
There was no official planning committee for this mitigation plan. Main personnel involved were:

Steve McMaster – Nebraska Department of Natural Resources
Randy Behm – U.S. Army Corps of Engineers
Jeffrey Brady – U.S. Army Corps of Engineers
Paul Woodward – Papio-Missouri River Natural Resources District
Papio-Missouri River Natural Resources District Board

<u>Elected officials and/or personnel involved in this multi-jurisdictional planning process</u>:

Arlington, Village of
- Gene Harris, Village Board
- Gordon Stork, Sewage Plant Operator

Bennington, Village of
- Louis Kologenski, Volunteer Fire Department

Blair, City of
- Phil Green, Assistant City Administrator
- Daryl Miller, citizen
- Kent Wilcox, citizen

Dakota County
Randy Crombie, Dakota County Highway Superintendent
Douglas County
Jim Rogers, Douglas County Emergency Management Agency Assistant Director
Lisa Rink, Grant Writer
Elkhorn, City of
Jesse Robinson, Building Inspector and Floodplain Administrator
Fort Calhoun, City of
Ron Woracek, City Engineer
Larry Brodkey, City Attorney
Herman, Village of
Ray Polley, Village Trustee
Homer, Village of
Darrin Brand, Village Trustee
Corbet Dorsey, Village Board
Jackson, Village of
Donna Hirsch, Village Clerk
Kennard, Village of
Duane Wilcox, citizen
LaVista, City of
Joe Soucie, Public Works Director
Omaha, City of
State Senator Gwen Howard
Barb Nichols, citizen, former NRD Board member
Papillion, City of
Mark Stursma, Planning Director
Sharon Whalen, President of Papillion Tree Board
Papio-Missouri River Natural Resources District
Paul Woodward, NRD Engineer
Rick Kolowski, NRD Board
Dorothy Lamphier, NRD Board
Ralston, City of
Ron Woracek, City Engineer
Mike Kennelly, Emergency Management Coordinator
Sarpy County
Larry Lavelle, Emergency Manager
Joe Mastandrea, Sarpy County Emergency Management Agency
Lisa Rink, Grant Writer
South Sioux City
Lance Hedquist, City Administrator
Springfield, City of
Sandra Powell, City Administrator
Tekamah, City of
Mayor Bill Anderson
Mary Beavers, Tekamah City Clerk
Gail Twining, City Council

Mark Jackson, Editor of Burt County Plaindealer Newspaper
Thurston County
Don Newton, County Road Superintendent
Valley, City of
Mayor Mary Caffey
Washington County
Daryl Miller, Washington County Board
Duane Wilcox, Washington County Board
Kent Wilcox, Washington County Board
Jeff Quist, Washington County Supervisor
Washington, Village of
Louis Kologenski, Volunteer Fire Department
Duane Wilcox, citizen
Waterloo, Village of
Troy Peterson, Emergency Manager
Chad Witt, Fire Chief
Stan Benke, Lyman Richey

Other plans/documents used in the development of this mitigation plan:

- The flood portion of this plan was largely completed by the US Army Corps of Engineers, which has a different flood document library.
- *Flood Insurance Study* was used to supplement the information from the Corps of Engineers with additional information about specific flood history. FIS information was obtained for: Arlington, Blair, Douglas County, Elkhorn, Fort Calhoun, Homer, LaVista, Omaha, Papillion, Ralston, Sarpy County, South Sioux City, Springfield, Tekamah, Valley, Washington County, and Waterloo.
- Community Comprehensive Plans were used to identify future growth areas and objectives.
- Proprietary NDNR spreadsheet of significant historic flood events in Nebraska.

Public Participation

To begin the planning process, a series of four initial public meetings was held. They took place in the following locations and dates:

August 3, 2005: Douglas County meeting at Elkhorn High School Lecture Hall
August 4, 2005: Sarpy County meeting at Papio-Missouri River NRD Headquarters
August 24, 2005: Washington and Burt County meeting at Tekamah City Auditorium
August 31, 2005: Dakota and Thurston County meeting at Papio-Missouri River NRD, Dakota County Office

During these public meetings, citizens of the Papio NRD identified four main goals of this mitigation planning effort:

1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety,
3) Increase public education about natural hazard events in their community, and
4) Increase or enhance public green space.

Sign-in sheets and other public participation documentation is provided in this report as **Appendix C**.

III. Organization of Plan

Chapter 1 – presents the purpose and goals of the plan, methodology used, organization of the plan, and a background study of the Papio NRD.

Chapter 2 – by section, known hazards in the Papio NRD are identified. For each hazard, a background, list of historical events, hazard assessment, vulnerability assessment, and possible mitigation actions is also given.

Chapter 3 – outlines the public participation process undertaken during the planning process, for prioritizing projects, and for updating the plan.

Chapter 4 – addresses implementation procedures and a process for updating the plan.

IV. Papio-Missouri River Natural Resources District – Background

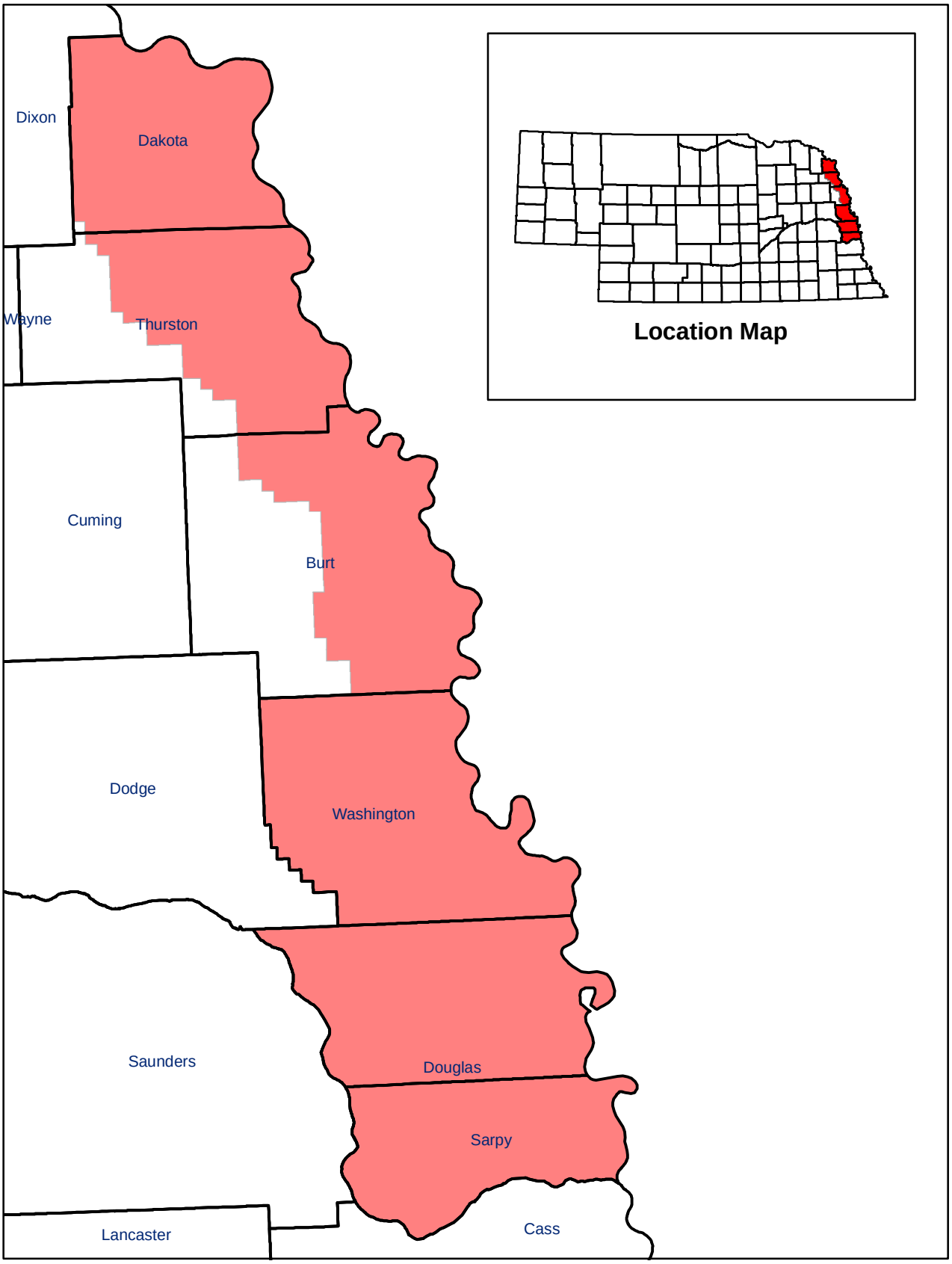
Nebraska's Natural Resources Districts were created by the Nebraska Legislature and began serving the people of the state in 1972. The legislature combined 154 special purpose resources management entities, including county soil and water conservation districts, drainage districts and watershed boards into 24 NRDs. In 1989, this number was reduced to 23 NRDs through a merger of the Papio-Missouri River NRD and the Middle Missouri Tributaries NRD. Natural resources districts are unique to Nebraska – no other state has a system for managing its natural resources identical to our NRDs. The extent of the Papio NRD boundary is shown on the next page as **Figure 1**.

NRDs are local government units with broad responsibilities to protect and enhance our state's natural resources. Major Nebraska river basins form the boundaries, enabling the NRDs to respond best to local needs.

Elected boards govern each district. Much of the funding for resources management programs and projects come from property taxes amounting to approximately one percent of property taxes collected in the area served by the district.

Partnerships built between NRDs and other resources management agencies - both state and federal - have strengthened the overall conservation effort. Nebraska's Department of Natural Resources, Game and Parks Commission, and Department of Environmental Quality work closely with natural resources districts. Federal government partners often include the Federal Emergency Management Agency, USDA's Natural Resources Conservation Service, and Farm Services Agency. Others, such as the U.S. Army Corps of Engineers, Environmental Protection Agency, Fish and Wildlife Service, and National Park Service also join NRDs to effectively address local needs.

Figure 1
Papio-Missouri River NRD Boundary



	Dam Failure	Drought	Earth-quake	Flood	Summer Storm	Land slide	Winter Storm	Tornado /Wind	Wildfire
Probability	Low	High	Low	High	High	Low	High	High	Low
Extent	Limited	Limited	Unknown	Limited	Severe	Limited	Severe	Severe	Limited
Previous Occurrence	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No

Probability: Based on history, what is the likelihood this type of event will happen again?
- None, Low, Medium, or High

Extent – If this event were to happen, how extensive could the damage be?
- Zero, Limited, Severe, Full, or Unknown

Previous Occurrence: Is there an historic record of this type of hazard in the Papio NRD?

The above figure shows the cumulative input from each of the four initial public meetings and is not necessarily representative of individual communities. Community-specific information is provided in the sections in this plan for each participating community in **Appendix E**. The NRD adoption and each community's adoption resolution is provided in **Appendix F**.

In the initial public meeting for the development of this hazard mitigation plan, Papio NRD residents ranked their community most vulnerable to the hazard types in this order: severe summer storms, severe winter storms, tornadoes, flood, drought, dam failure, wildfire, earthquake, and landslide. Due to the geographical proximity, the following hazard types were not considered due to there being no likelihood of occurring in Nebraska: volcanic eruptions, avalanches, hurricanes, tidal surges, and tsunamis.

In the following sections, only the hazard types which have a significant likelihood of occurring or have a reason to potentially occur are listed. These types are: severe weather (summer and winter), tornado, flood, drought, and dam failure. Although there is a small risk for earthquakes, wildfires, and landslides, Papio NRD citizens did not rank it high enough to warrant detailed discussion in this plan. This may change in future updates.

NRD Vulnerability Assessment

With a financial vulnerability perspective, the Nebraska Department of Property Assessment and Taxation keeps records for counties but not by NRD boundary. Therefore, the county information will be inaccurate for the counties which are not completely within the Papio NRD (Burt and Thurston – **See Figure 1**). However, since western Burt County and western Thurston County are both sparsely-inhabited, the numbers will not be significantly incorrect. The entire taxable value of assets in the Papio NRD for 2005 was $40,290,231,815. Broken out by county, the total assessment valuation is:

	2005 Total
County	**Taxable Value**
BURT	$326,952,869
DAKOTA	$959,446,579
DOUGLAS	$29,210,992,160
SARPY	$8,148,816,108
THURSTON	$129,548,809
WASHINGTON	$1,514,475,290
	$40,290,231,815

Broken out by property class, the significant components of the total evaluation are:

Residential real property:	$26,263,554,892 (65% of total)
Commercial real property:	$ 8,243,849,062 (21%)
Commercial/Industrial personal property:	$ 1,936,364,151 (5%)
Industrial real property:	$ 1,757,346,368 (4%)

Realistically, the entire building stock within the complete NRD boundary will not all be impacted by one disaster event. However, each structure in the NRD is at the same vulnerability to disaster types like severe weather and tornadoes.

For smaller communities, the NDNR completed fieldwork which determined the number of structures by main structure type (residential, commercial, public, non-profit, and out buildings). For the larger communities of the Omaha metropolitan area, Blair, and South Sioux City, the intent was to use HAZUS software program to assist with the vulnerability assessment since it would not be possible to drive every street in those communities. However, due to technical difficulties, the HAZUS analysis was not able to be completed within the grant period. As a result, the structural inventory is identified as a task which will be provided in the plan's update in five years.

2.10 SEVERE WEATHER

2.11 Background

Severe weather can be separated into severe winter storms and severe summer storms. Weather hazards for severe summer storms include the qualities of a storm which make it severe: winds exceeding 58 mph and hail in excess of ¼-inch diameter. For the purposes of this plan, severe summer weather will also include intense rainfall and frequent lightning. Weather hazards for severe winter storms are not defined, but usually include many of the following: extreme cold, heavy snowfall, ice, and strong winds which push the wind chill well below zero degrees. An additional summer weather hazard that is not storm-related is intense summer heat.

In the non-winter months, thunderstorms and supercell thunderstorms produce lightning, and severe storms can produce hail. Lightning is one of the most consistent causes of death for natural hazards in Nebraska because it can kill people who are outside when a thunderstorm is overhead or nearby. Although hail has the potential to kill people, the primary risk is to property

like windows, roofs, siding, trees, and cars. In Nebraska, hail can also cause total losses in agricultural fields across extensive areas. Strong winds down tree limbs and power lines, in addition to having the potential for causing significant property damage and community interruption. Structure owners can obtain insurance to cover themselves financially, but there may be ways to prevent tree damage from occurring through property urban tree management.

Periods of extreme heat are common in all parts of Nebraska during the warmest months. The problem is made worse when the high temperature is accompanied by high humidity. The main risk for intense heat is to persons who may become isolated in an unventilated area. Recorded deaths in Nebraska that are associated with extreme heat are largely a result of outdoor exercise or work during this kind of weather condition. The very young and very old are at additional risk because they tend to have weaker respiratory systems.

For severe winter storms, heavy snow can bring a community to a standstill by inhibiting transportation (like whiteout conditions), knocking down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough so that precipitation falls as freezing rain rather than snow.

Extreme cold can lead to hypothermia and frostbite in people who are exposed to the weather without adequate clothing protection. Cold causes fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. Extreme cold also increases to likelihood for ice jams on flat rivers or streams. When combined with high winds from winter storm, extreme cold becomes extreme wind chill, which is extremely hazardous to health and safety.

2.12 Severe Weather History

Through its National Climate Data Center (NCDC), the National Oceanic and Atmospheric Administration (NOAA) compiles a list of recorded storm events. These records go back to 1950; however, reports were given by county only, and community-specific information was not provided until 1993.

Hail

Since 2000, there has been an increase in the number of hail events impacting the Omaha metropolitan area, Blair, and other communities in the NRD. Following are only the most damaging hail events, as given by the National Climate Data Center.

July 24, 1995: $300,000 in property damage caused by 1¾-inch hail, downtown Omaha.
May 17, 1996: $200,000 in property damage reported from 2¾-inch hail in Elkhorn.
July 16, 1996: $500,000 in property damage was caused by 1¾-inch hail in South Sioux City. Coupled with strong winds, this hail event destroyed more than half of Dakota County's corm and bean acreage, resulting in an estimated $22 million in damage.

July 27, 1996: $300,000 in damage to aircraft and vehicles at Offutt Air Force Base, $5000 in property damage was reported near Dakota City on the same day.
July 2, 1999: 1-inch hail caused $1.8 million in damage to 5000 acres of corn and soybeans. South Sioux City witnessed $200,000 in property damage to vehicles and buildings.
April 10, 2001: Property damage estimated at $300 million caused by a 5- to 15-minute hail storm in Omaha which consisted of hail in the ½-inch to 1 ½-inch range. There was one reported injury caused by this hail event. State Farm estimated 100,000 home insurance claims as hail drifted like snow across sidewalks and roads.
April 30, 2001: The second major hail event in three weeks caused an additional $200 million in property damage in Elkhorn and western Omaha.
May 13, 2001: Hail up to three inches in diameter caused significant damage to commercial and private aircraft at Eppley Airfield in Omaha. Combined with residential property damages, the damage estimate topped $1 million.
July 25, 2002: $100,000 in property damage caused by 1¾-inch hail near Jackson.
May 4, 2003: 2½- to 4½-inch hail reported from Gretna to Bellevue, no damage reports.
June 9, 2003: $50,000 in vehicle and window damage caused by 1¾-inch hail in Jackson.
May 22, 2004: Hail up to baseball size fell in Blair, causing extensive damage to car dealership inventories and residences. Damage totals for Dodge County and Washington County was $10 million, with at least half of this amount coming from Washington County and Blair.
June 4, 2005: Up to 4-inch hail caused scattered damage in the Papillion area.
June 27, 2005: 4¼-inch hail was reported in Pender – no damage estimates available.

In the last ten years, nearly every year has had at least one major hail event. It would be safe to assume that damaging hail storms occur somewhere in the Papio NRD at least one time per year.

Severe Summer Storms:
It is safe to say that at least one severe winter or summer storm will occur every year, and a detailed history of these events would be too extensive to chronicle. According to the NCDC statistics since 2000, the following counties experienced this many severe thunderstorms (in parenthesis) in each year:

Sarpy:	2000 (2), 2001 (3), 2002 (4), 2003 (3), 2004 (3), 2005 (4)
Douglas:	2000 (4), 2001 (4), 2002 (3), 2003 (3), 2004 (8), 2005 (2)
Washington:	2000 (2), 2001 (2), 2002 (2), 2003 (3), 2004 (3), 2005 (2)
Burt:	2000 (1), 2001 (4), 2002 (0), 2003 (3), 2004 (1), 2005 (1)
Thurston	2000 (1), 2001 (1), 2002 (1), 2003 (3), 2004 (1), 2005 (1)
Dakota	2000 (4), 2001 (3), 2002 (2), 2003 (4), 2004 (2), 2005 (2)

Noteworthy severe summer storms and weather events are:
April 25, 1996: a boy was killed in Omaha when wind gusts up to 70 mph toppled a tree, which fell on him as he played outdoors.
June 12, 1996: A dry microburst near Valley was recorded with wind speeds up to 92 miles per hour, which snapped off ten power utility poles, tore the roof off a convenience store, and overturned several central-pivot irrigation systems within a mile radius of the National Weather Service office. Damage for this event was placed at $80,000.

July 16, 1996: Thunderstorm winds caused widespread damage estimated at $3 million in property damage and $3 million in crop damage from Homer to South Sioux City. There was widespread tree damage, downed power poles and lines, farm buildings were destroyed, and homes were damaged. Winds were measured at 70 knots, which equals slightly more than 80 mph.

April 5, 2000: Sustained winds of 40-50 mph and gusts over 60 mph caused $20,000 in structural damage in South Sioux City and fanned grass fires near Hubbard.

September 2, 2000: 60 mph winds caused $3000 to outbuildings near Herman.

April 20, 2001: Thunderstorm gusts estimated at 70-80 mph did major roof damage to several homes and businesses in Papillion. Damage was estimated at $250,000.

June 13, 2001: $50,000 in property damage was caused by strong winds in South Sioux City.

July 25, 2002: Thunderstorm winds severely damaged grain elevators on a farm and caused tree damage in and around Homer. Damage was estimated at $20,000. This same storm brought 70 mph winds to Jackson, which destroyed or damaged several buildings, resulting in $500,000 in damage, extensive tree damage, and power outage.

October 1, 2002: An intense thunderstorm brought hail and 100 mph winds from five miles southwest of Fort Calhoun into the Fort Calhoun area. Extensive tree damage was reported, and two injuries were caused when the strong winds destroyed a house northwest of Fort Calhoun. Another injury was reported when a person was caught outside in the wind-driven hail. An estimated 85% of homes in Fort Calhoun sustained damage to some degree. The storm caused an estimated $3 million worth of damage.

July 5, 2003: A large bowing line of thunderstorms dropped temperatures more than 20 degrees in addition to causing brief intense rain and wind gusts up to 87 mph. $2 million in damage was reported in Omaha, especially due to the larger trees in the central and eastern sections of town. Extensive tree damage across the city brought down power lines and cut power to 60,000 OPPD customers. OPPD also estimated cleanup expenses at $200,000.

August 18, 2003: A strong thunderstorm caused a tree to fall on a home in Homer, resulting in $10,000 in property damage.

July 12, 2004: 70 mph winds downed large trees and power lines in Blair. Many homes and cars sustained damage, and power was knocked out to parts of the city for up to 24 hours. Several people narrowly escaped severe injury or death, and damage was estimated at $100,000.

March 10, 2005: Sustained winds of 30-40 mph with gusts over 60 mph overturned semi trailers and injured one person in Decatur .

May 10, 2005: Thunderstorm wind gusts of 62 mph brought down trees on homes and other private property in western and northern Omaha. Damage was estimated at $500,000. 13,000 OPPD customers were without power from the storms. This same line of storms caused minor damage to buildings in Dakota County.

July 25, 2005: Thunderstorm winds caused damage to trees and structures estimated at $500,000 in the Jackson area.

It is safe to assume that a severe summer storm will occur in the Papio NRD boundary at least once per year.

Lightning:
Since 2000, there were no reported lightning strike damages for Dakota County, Thurston County, Burt County, Washington County.

There are twelve reported lightning events for Douglas County, with one death and three injuries. The death occurred on July 17, 2001, to a man who was outdoors on a bicycle trail. Two men were injured when lightning struck them near Lake Zorinsky in Omaha on May 29, 2004. The third injury occurred on July 2, 2004, when lightning struck the ground near a woman who was standing outside. Many of the other lightning events struck buildings and caused fires – damage figures range from $5000 to $165,000.

Three lightning events were recorded for Sarpy County, causing only property damage and no fatalities or injuries. The worst lightning strike hit a home in Bellevue on August 17, 2002, causing $125,000 in damage.

Severe Winter Storm
One of the most spectacular and harrowing events in the history of the Great Plains was the Blizzard of January 12, 1888. Other storms had produced colder temperatures and greater amounts of snow. It was the combination of gale winds, blinding snow, and rapidly falling temperatures that made the 1888 blizzard so dangerous. No accurate count of the total deaths from the storm is possible, but estimates for Nebraska have ranged from 40 to 100.

The Blizzard of 1975 occurred in January and dropped 19 inches of snow. Winds up to 65 mph, and rapidly falling temperatures left the Omaha virtually paralyzed for days. Ten people died in Omaha, and only heroic effects by thousands of unknown people kept the toll from being higher.

The major snow and ice storm on October 25 and 26, 1997, ranks as a snow event likely to be seen once in only 200 years. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully- or partially-leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area and 25% of the trees in the Lincoln area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha and Lincoln areas were opened for use by those who suffered a hardship from the storm. Property damage was estimated at $56.5 million with crop damage an additional $1.6 million.

Like severe summer storms, it is a virtual certainty that the Papio NRD area will experience a severe winter storm every year. Since 2000, the following counties experienced this many severe thunderstorms (in parenthesis) in each year:

Sarpy:	2000 (3), 2001 (3), 2002 (3), 2003 (3), 2004 (4), 2005 (1)
Douglas:	2000 (3), 2001 (4), 2002 (2), 2003 (4), 2004 (4), 2005 (1)
Washington:	2000 (3), 2001 (4), 2002 (3), 2003 (4), 2004 (4), 2005 (1)
Burt:	2000 (2), 2001 (2), 2002 (3), 2003 (3), 2004 (4), 2005 (1)
Thurston:	2000 (1), 2001 (2), 2002 (3), 2003 (2), 2004 (3), 2005 (1)
Dakota:	2000 (1), 2001 (2), 2002 (2), 2003 (4), 2004 (6), 2005 (1)

Temperature extremes:
Although extreme heat and extreme cold are not common, they are also not rare. What makes these events truly dangerous is when extreme heat is combined with high humidity and when extreme cold combines with high winds to produce dangerous windchills.

On July 10-14, 1995, three people died in eastern Nebraska due to high temperatures and humidity. Also during this time, $150,000 in property damage due to cattle deaths and $160,000 in crop damage was reported. From July 19-30, 1999, daytime temperatures were over 90 to low 100s and overnight lows stayed in the 80s in eastern Nebraska. Combined with high humidity, this heat wave killed two people in the Omaha metropolitan area: a young jogger outside and an elderly man in a trailer with a broken air conditioner. An estimated 5000 head of cattle perished, pushing the total damage from this event to reach $3.3 million. A woman died in her uncooled apartment in South Sioux City during the period of July 28-29, 1999, when heat indices exceeded 120 degrees. On July 28 to August 9, 2001, high temperatures and very high humidity combined to kill one person while he was outside working. On July 22-24, 2005, $3 million in cattle deaths was reported in eastern Nebraska due to a temperature of 105 degrees and stifling humidity. The heat also lead to the death of an infant left briefly in a vehicle.

Extreme cold temperatures can get down to –20 or –30 degrees. When combined with high winds, recorded extreme wind chills are most commonly –30 to –50 degrees. Sub-zero temperatures were recorded for 63 consecutive hours on February 1 to 4, 1996. One injury was reported due to frostbite. Combined with low temperatures, 55 mph winds on January 10, 1997, produced a windchill lower than –70 degrees. On January 22, 2003, a homeless man in Omaha died from severe frostbite suffered during the -30 degree windchill. Windchills of -25 degrees were recorded on January 6, 2004. During this event, an elderly woman in Omaha went out to check on her vehicle during the early morning hours, and passed away after falling and incapacitating herself.

Previous NRD Severe Weather Mitigation Actions
Severe weather preparedness, response, and mitigation are primarily responsibilities of county and region emergency management agencies in the area. For this reason, the Papio NRD has not assisted with or completed severe weather mitigation projects. However, through its Conservation Assistance Program, the NRD has helped with tree planting which has reduced tree-related damages in the urban forest of the Omaha metropolitan area.

2.13 Probability of Severe Weather Events

It is certain that the Papio NRD area will continue to be impacted by severe summer storms and severe winter storms, along with the various dangerous and damaging components which accompany both.

2.14 Vulnerability Assessment of the Severe Weather Hazard

Every structure in every community participating in this planning effort is at equal risk to hail damage or being impacted by other severe weather events. According to the Nebraska Department of Property Assessment and Taxation, this represents approximately

$40,290,231,815. See the community-specific section for a more structural inventory and financial damage potential for each city.

2.15 Potential Severe Weather Mitigation Measures

Like tornadoes, there is little one can do to mitigate severe weather events – just be prepared.

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

Objective 3.1 Ensure continued operation of critical facilities, utilities, and the local transportation system.

- Action 3.1.1: Work with owners of critical facilities to ensure they are adequately protected against extreme winter conditions and have an uninterruptible power supply.
- Action 3.1.2: Work with schools and other critical facilities to ensure that they receive severe weather warnings – perhaps have them purchase weather radios.
- Action 3.1.3: Develop a snow route plan for the community that takes major streets and critical facilities into account. Post "Emergency Snow Route" signs along this route and educate the public to keep their vehicles off of these routes during heavy snow events, or risk being towed. Publish this route in the local telephone books or other locations which could be referenced by the majority of Papio NRD residents.
- Action 3.1.4: Require all new development, where appropriate, to bury all electric lines.
- Action 3.1.5: Work with local property owners in developed areas to bury power lines in areas which experience power outages due to downed lines.

Objective 3.2: Reduce tree-related damage to property and utilities

- Action 3.2.1: Develop an urban tree management plan. As a free service, the Nebraska Forest Service offers advice on proper "urban forest" planning, tree selection, planting, and tree care. This service should be utilized in areas of the city which experience more tree-related problems. The Nebraska Forest Service performs a free "Tree inventory" and offers technical advice for communities. Communities can then use this information to develop or change their local tree programs.
- Action 3.2.2: Bury overhead power lines and service lines in areas where tree problems exist.
- Action 3.2.3: Require new development to bury main and service electric lines
- Action 3.2.4: Communities can provide information about proper tree selection (especially in power line rights-of-way) and maintenance to residents.
- Action 3.2.5: Communities should consider becoming a "Tree City USA". This program is offered through the National Arbor Day Foundation, and through it communities receive direction, technical assistance, public attention, and national recognition for their urban and community forestry programs through the Nebraska Forest Service and USDA Forest Service.

Goal 3: Increase Public Education

Objective 3.2: Increase severe weather awareness

- Action 3.2.1: For awareness, severe weather safety tips could be made public by newspaper

or other media outlets. Such a campaign should include practical tips like staying indoors when lightning is around and recommended behavior during extreme temperatures. This could be combined with awareness campaigns from other disasters.

- Action 3.2.2: The city could develop a Severe Weather Preparedness Week outreach program to educate children and/or the public about the nature of different disaster types, where to watch for storm warnings, what to do, where to go during a severe weather warning, and others.

2.20 FLOOD

2.21 Background

Flooding has been a major problem for many of the communities in the Papio NRD. Omaha was settled and developed largely because of its proximity to the water resources provided by the Missouri River. Other communities were founded on rivers and creeks for similar reasons. The Papio NRD has the distinction of having the three major Nebraska rivers within its boundary: the Platte River, Missouri River, and Elkhorn River. Before large Missouri River main stem dams were completed by the Corps of Engineers in the 1940s to 1960s, Nebraska communities situated on the Missouri River had an extensive history of Missouri River flooding. These communities were South Sioux City, Dakota City, Decatur, Blair, and Omaha. The entire reach of the Missouri River from the northwest corner of Dakota County to the southeast corner of Sarpy County is under the NRD's administration, which means that it must deal the stormwater problem of steep tributaries draining to Missouri River bottomlands.

The second major Nebraska river which impacts the Papio NRD is the Platte River, which flows along Sarpy County's southern border. Problems with the Platte River in the Papio NRD boundary have not been significant when compared to other communities on the Platte like North Bend, Columbus, and Grand Island. However, Valley, Waterloo, and unincorporated areas of Sarpy County have historically been impacted by Platte River flooding.

The third major Nebraska river to impact the Papio NRD is the Elkhorn River, which acts as the NRD's western border for Washington County. Like the Platte River, the Elkhorn's flood problems are not as significant in the Papio NRD area as they are in other upstream locations – in this case for communities like Norfolk, West Point, Hooper, and Nickerson. However, the communities on the Elkhorn which are in the Papio NRD boundary which have experienced flooding are Arlington, Valley, Waterloo, and King Lake.

In addition to the three major Nebraska rivers, the NRD must also work with the Big Papillion Creek, which drains the majority of the Omaha metropolitan area through its main stem and tributaries.

In addition to the normal riverine flooding, the Papio NRD is also forced to deal with ice jams on the Platte River. Although other NRDs are on the other side of the Platte, most of the damages from ice jams occur on the Papio NRD side of the River. One of the worst ice jams occurred in 1978 when ice conditions helped the Platte River to overtop the Union Dike. As a result, the entire city of Valley was flooded.

Repetitive Loss Properties in the Papio NRD

A repetitive loss property is defined as any structure which has had two or more flood insurance claims filed for it in any ten-year period since 1978. The Federal Emergency Management Agency (FEMA) has started targeting mitigation efforts for these repetitive loss properties because of the significant drain they represent to the flood insurance pool of the National Flood Insurance Program. Mitigation of these properties in Nebraska has been slow because of the regulation which requires the jurisdictions the properties are in to have an adopted and approved all-hazards mitigation plan as a condition of eligibility for federal mitigation assistance. Once this NRD all-hazards mitigation plan is approved, Nebraska will finally be in a situation to mitigate some of these repetitive loss properties.

According to the 2005 Repetitive Loss list provided by FEMA in January 2006, the following communities have this many repetitive loss properties:

Arlington: 2
Bellevue: 11
Douglas County: 17
Fort Calhoun: 4
Omaha: 11
Sarpy County: 122
Springfield: 3
Valley: 2
Washington County: 8
PAPIO NRD TOTAL: 180

Of the 317 properties on the list, the 180 properties in the Papio NRD represents 57% of the State's repetitive loss properties. It should be stated that the repetitive loss list is notoriously inaccurate, especially when it comes to having the correct jurisdictional name. For example, the two repetitive loss properties listed for Valley should be listed under Douglas County since both are located in the Sokol Camp area. However, no matter where they are located, they ought to be and will be considered as good acquisition candidates.

2.22 Flood History

Historic Flood Events

Since floods impact communities and not areas, more detailed and older flood records have been placed in the community-specific section in **Appendix E**. The National Climatic Data Center (NCDC) has flood events recorded for counties since 1994. Prior to 1994, some of the significant flood events which impacted communities in the Papio NRD area were (* denotes floods of record):

- Missouri River: 1881, 1943, 1947, 1950, 1952*, 1978, 1984
  South Sioux City, Dakota City, Blair, Omaha, Bellevue
- Elkhorn River: 1881, 1917, 1920, 1940, 1944*, 1960, 1962, 1970, 1978, 1990
  Waterloo, Valley, Arlington, King Lake
- Platte River (at Louisville): 1881, 1882, 1912, 1936, 1944, 1947, 1952, 1960* (highest stage from ice jam), 1962, 1967, 1970, 1978, 1984, 1993* (highest flow volume)

- Big Papillion Creek: 1950, 1952, 1959, 1964*, 1965
  Omaha, Irvington, Fort Crook, Papillion, Millard, Ralston, Bennington, Bellevue
- Little Papillion Creek: 1960, 1964, 1965*
  Omaha
- West Branch Papillion Creek: 1948, 1959, 1964*, 1965
  Elkhorn, Papillion
- Omaha Creek: 1922, 1940*, 1954, 1957, 1967, 1993
  Homer
- Tekamah Creek: 1904, 1915, 1944*, 1963, 1974
  Tekamah

The following is a list of each flood event after 1994 given in NCDC's database by county in tabular format first, followed by a narrative description of each even.

Sarpy County

There is an extensive history of flooding in Sarpy County due to its proximity to the Missouri River on the east, Platte River on the west and south, and Big Papillion Creek through its middle. Much of this area is urbanized, which typically compounds flood problems.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Platte River	02/18/1994	0000	Flood	N/A	0	0	0
2 Platte River	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
3 Missouri River	04/02/1997	12:00 PM	Flood	N/A	0	0	0
4 Near Offutt AFB	06/24/1997	02:00 AM	Flood	N/A	0	0	1.1M
5 Countywide	09/02/1997	01:35 AM	Flash Flood	N/A	0	0	0
6 Platte River	03/16/1998	02:52 PM	Flood	N/A	0	0	23K
7 La Platte	06/13/1998	11:25 PM	Flash Flood	N/A	0	0	0
8 Bellevue	08/07/1999	02:00 AM	Flash Flood	N/A	0	0	0
9 Platte River	03/14/2001	05:00 PM	Flood	N/A	0	0	0
10 Gretna	08/22/2002	11:50 PM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	1.743M

February 18-20, 1994

Ice action caused minor overflows along the Platte River. An ice jam forced the river to locally reach around two feet over bank-full for a short time in Sarpy County. Some residents of the Beacon View housing area were evacuated and the flooding caused an undetermined amount of water damage to homes.

February 18-28, 1997

Mild temperatures melted snow cover in a short time period allowing for a sudden runoff into streams and rivers which were still intact with thicker-than-normal ice. The runoff into the streams and rivers was sufficient to break up the ice, and ice jams formed at many locations,

causing flooding. Serious flooding occurred on the lower Loup and lower Platte rivers. The strongest and most urban flooding occurred in the stretch of the Platte river along Saunders County and Sarpy County between the mouth of the Elkhorn river to the Highway 6 bridge near Linoma Beach/Beacon View. This was the result of a 2½ mile long ice jam along the Platte river. Thomas Lakes was severely impacted with ice jam flooding, and homes in Beacon View were also flooded. Several structures at Camp Ashland were flooded, forcing the evacuation of 150 people. Two to three days of dynamiting the Platte river ice jam near Beacon View beginning on the 20th did much to break up the strongest ice jam that acted as the main blockage in the area.

April 2 – May 3, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

June 24, 1997
Heavy rains caused debris to clog a drainage ditch near a railroad track. The ditch filled with water and washed part of the track away. This lead to a derailment of 28 train box cars near Offutt Air Force Base that were filled with grain.

September 2, 1997
A cluster of thunderstorms dumped rains of three to five inches in the Papillion Creek basin in and near Omaha, causing numerous pockets of urban flooding. Streets were closed streets in several locations in the Omaha metropolitan area.

March 16 – March 18, 1998
Ice jamming was evident near the confluence of the Platte and Elkhorn rivers near Vencil's Island. Most of the flooding occurred on the west side of the Platte river. Demolition experts used dynamite to open up channels near Vencil's Island and Woodcliff. The dynamiting was successful and water levels receded.

June 13, 1998
Water flowed two to three feet deep over the Highway 75 Platte River bridge near La Platte.

August 7, 1999
Heavy rain from this event caused Douglas, Washington, and Burt County to be declared federal disaster areas. Although not as heavy as locations to the north, rainfall of two to seven inches in a 24-hour period was reported over Sarpy county. Flash flooding was confined to mainly farm fields, but several roads, including 36th Street and Highway 370, were flooded.

March 14-16, 2001
A one-mile ice jam and other smaller ice jams caused considerable flooding along the Platte River, especially southwest of Valley near Sokol Camp and Vencil's Island. The higher river level and ice jams were the result of several warm days that caused snow melt and ice breakup.

The ice was unusually thick, around 12 to 18 inches, due to a colder than normal winter season that saw prolonged subfreezing temperatures. Sokol Camp was evacuated due to water that came over a local dike that protected the mainly summer-type cabins, and an evacuation by boat was needed for a residence at Vencil's Island.

August 22-23, 2002
Heavy rain producing thunderstorms tracked across parts of southeast and east central Nebraska. In Sarpy county, flood waters sent water and mud two to three feet deep across Highway 6 southwest of Gretna.

Douglas County
Like Sarpy County, there are many flood sources, most with urbanization pressure which compounds flood problems.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Douglas County	06/22/1994	0630	Flash Flood	N/A	0	0	0
2 Douglas County	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
3 Douglas County	04/02/1997	12:00 PM	Flood	N/A	0	0	0
4 Missouri River	05/01/1997	12:00 AM	Flood	N/A	0	0	0
5 Platte River	03/16/1998	02:52 PM	Flood	N/A	0	0	23K
6 Omaha	08/07/1999	01:15 AM	Flash Flood	N/A	1	0	11.0M
7 Platte River	02/06/2000	12:30 PM	Flood	N/A	0	0	0
8 Platte River	03/14/2001	05:00 PM	Flood	N/A	0	0	0
9 Omaha	05/24/2004	04:07 PM	Flash Flood	N/A	0	0	0
10 Omaha	07/22/2004	03:50 AM	Flash Flood	N/A	2	0	0
				TOTALS:	3	0	11.643M

June 22, 1994
Two to five inches of rain fell in a short amount of time, which forced Cole Creek out of its banks in Omaha. The flood water affected a car dealership, residential yards, baseball fields, and a golf course. Approximately 150 vehicles had water damage at the car dealership, and widespread street flooding was reported.

February 18, 1997
Mild temperatures melted snow cover in a short time period, allowing for a sudden runoff into streams and rivers, which were still intact with thicker than normal ice. The runoff into the streams and rivers was sufficient to break up the ice. Ice jams formed at many locations, causing serious flooding on the lower Loup River and Platte River. A 2½ mile ice jam on the Platte River caused the worst flooding along a stretch between the mouth of the Elkhorn River downstream to the Highway 6 bridge near Linoma Beach/Beacon View. Thomas Lakes was severely impacted with ice jam flooding, and Beacon View homes were also flooded. Nearly 3000 acres of farmland in western Sarpy county were flooded when the local levee was

overtopped upstream of Beacon View. Two to three days of dynamiting of the Platte River ice jam near Beacon View beginning on the 20th did much to break up the strongest ice jam.

April 2 – May 20, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

September 2, 1997
Strong storms dumped three to five inches of rain in the Papillion Creek Basin in and near Omaha. This caused numerous pockets of urban flooding and closed streets in several locations in Douglas County and within the Omaha city limits.

March 16, 1998
Ice jamming was evident near the confluence of the Platte and Elkhorn rivers near Vencil's Island. Most of the flooding occurred on the west side of the Platte River. Demolition experts used dynamite to open up channels near Vencil's Island and Woodcliff. The dynamiting was successful and water levels receded.

August 7, 1999
Record rains caused extensive flooding over the Omaha metropolitan area and surrounding counties. Rainfall at Eppley Airfield in Omaha totaled 10.46 inches in a 24- hour period, which was the most rainfall recorded in a 24 hour period in Omaha since 1900. The heaviest rain was mainly confined to the eastern part of Omaha, with amounts in the 8 to over 10 inch range. Rainfall generally tapered down in western Douglas County. The Aksarben area in the central Omaha reported around seven inches, Boystown saw a little over five inches, while the National Weather Service office in Valley only received around 2½ inches. The rain caused extensive flooding along Cole Creek in the east-central part of Omaha, where one man drowned after his basement wall washed out. Flooding on the Big Papillion Creek caused substantial damage to two golf courses and a nursery. The Metro Area Transit Headquarters was hit by an eight-foot wall of water which flooded equipment and numerous buses, and caused around $4.5 million of damage. More than 1000 homes, 8 apartment complexes, and over 30 businesses sustained significant damage from flooding, with total damage estimated at between $6.5 million and 11 million. Flooded basements, collapsed walls, and damaged vehicles appeared to bear the brunt of the damage in the Omaha Metro area. Douglas, Burt, and Washington counties of east central Nebraska were declared Federal disaster areas.

February 6-9, 2000
An extensive ice jam from just upstream of Leshara downstream to near the Highway 92 bridge caused lowland flooding along the Platte River. Union Dike prevented more significant flooding from occurring. However, an access road for residences on County Road T, just east of Leshara, flooded. Overall, a 10-mile stretch of the river was flooded due to this ice jam.

March 14-16, 2001
A 1-mile ice jam and other smaller ice jams caused considerable flooding along the Platte River, especially southwest of Valley near Sokol Camp and Vencil's Island. The higher river level and ice jams were the result of several warm days that caused snow melt and ice breakup. The ice was unusually thick, around 12 to 18 inches, due to a colder than normal winter season that saw prolonged subfreezing temperatures. Sokol Camp was evacuated due to water that came over a local dike that protected the mainly summer-type cabins, and an evacuation by boat was needed for a residence at Vencil's Island.

May 24, 2004
Flash flooding was reported across sections of central and eastern Omaha. The flooding was caused by heavy rain of 2 to 3 inches which fell across much of the central, eastern and southern sections of the city over a several hour period during the late afternoon hours. 2.28 inches was reported at Eppley Airfield. The ground over much of the area was already nearly saturated from a two to three inch rain that fell two days earlier. Four- foot deep flood waters stranded cars in the Saddle Creek and Farnam areas, and a health center reported that floodwater flooded a wing of the unit.

July 22, 2004
Heavy rainfall in the Omaha metropolitan area caused areas of flash flooding, especially near the Saddle Creek and Center Street areas, near the intersections of 96th & Q, 17th & Ames Avenue, and 108th & Q. It was near that last location where a 29-year-old male apparently drowned after his car became stalled in flood waters and he was swept away in a nearby drainage ditch as he was walking for help. Other flooding occurred when a pool of water six feet deep near the Saddle Creek location carried off a few vehicles and flooded at least one apartment complex. Several businesses were flooded, and sewers backed up into properties. Eppley Airfield reported 2.66 inches of rain from the storm in two to three hours, while some locations in midtown Omaha received almost 3.5 inches of rain. After the flash flooding subsided, flooding was reported along the Big Papillion Creek. The creek at Fort Crook was above flood stage for around 2½ hours. Another person drowned during this event when his kayak flipped over in high water on one of the branches of the Papillion Creek system.

<u>Washington County</u>
Many of the flood reports for Washington County occurred on the Elkhorn River, which is the County's western boundary. However, the Papio NRD boundary does not stretch to the Elkhorn River and were therefore not included in this report.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Kennard	06/23/1996	01:00 AM	Flash Flood	N/A	0	0	0
2 Missouri River	04/02/1997	12:00 PM	Flood	N/A	0	0	0
3 Countywide	09/02/1997	01:35 AM	Flash Flood	N/A	0	0	0
4 Herman	06/08/1998	11:06 PM	Flash Flood	N/A	0	0	0
8 Countywide	07/05/1998	03:30 AM	Flash Flood	N/A	0	0	240K
9 Arlington	08/06/1999	10:00 PM	Flash Flood	N/A	0	0	4.0M

10 Blair	06/14/2001	02:10 AM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	4.240M

June 23, 1996
Rains of two to three inches fell over much of Washington County, pushing the Bell and Big Papio Creeks out of banks.

April 2 – May 3, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

September 2, 1997
A cluster of thunderstorms dumped rains of three to five inches in the Papillion Creek basin in and near Omaha, causing numerous pockets of urban flooding. Streets were closed streets in several locations.

June 8-9, 1998
Heavy rains caused some flooding near homes southwest of Herman. Up to a foot of water flowed over Highway 75 at New York Creek.

July 5, 1998
Heavy rain from thunderstorms produced flash flooding. New York Creek near Herman and Bell Creek just east of Arlington overflowed their banks. Some homes east of Arlington had to be evacuated, and eight of these homes were flooded. A portion of Highway 30 at Arlington had to be closed for a period of time. Nearly 3000 acres of soybeans were destroyed near Arlington.

June 14, 2001
Heavy rains caused flash flooding that briefly closed Highway 75 north of Blair. Flooding was also observed along Bell Creek near Arlington.

Burt County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Burt County	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
2 Tekamah	08/07/1999	02:30 AM	Flash Flood	N/A	0	0	500K
3 Oakland	04/30/2003	03:00 AM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	1.120M

The first flood occurred in extreme western Burt County closer to Nickerson – this area is outside of the Papio-Missouri River Natural Resources District boundary. The second flood

recorded for Tekamah was a federally-declared disaster (FEMA-1286). Maximum recorded rainfall was ten inches in less than twelve hours (verify with Tekamah info). Although only officially listed as impacting Tekamah, the entire eastern portion of Burt County witnessed similar flood problems, especially in valleys and low-lying areas adjacent to creeks. For the third flood, rainfall of 4½ to 6½ inches was reported three to four miles west of Oakland, with 5.37 inches measured in town. The rain flooded several tributaries of Logan Creek and flooded across several county roads, but otherwise caused very little damage.

Thurston County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Countywide	03/07/1993	0000	Flood	N/A	2	0	0
2 Walthill	06/25/2000	11:00 AM	Flash Flood	N/A	0	0	400K
3 Countywide	05/21/2004	11:15 PM	Flash Flood	N/A	0	0	0
4 Countywide	06/11/2004	01:15 AM	Flash Flood	N/A	0	0	0
				TOTALS:	2	0	400K

March 7, 1993
As a part of the unprecedented Great Midwest Flood of 1993, Thurston County witnessed flooding, just like most Nebraska counties and all counties in Iowa. However, since this damage report is prior to 1994, NCDC did not have specific details or damage amounts. The two deaths reported for this event are for the entire region and may not be specific to Thurston County.

June 25, 2000
Four to eight inches of rain which fell in five to six hours, causing flooding of several roads, mainly in eastern Thurston County. At least one road was partially washed out near Walthill, and more than 65 bridges and road culverts were damaged by the storm. The Natural Resources Conservation Service and the Thurston County Road Department estimated that the flooding caused around $400,000 worth of damage.

May 21, 2001
Heavy rainfall from thunderstorms during produced flash flooding across several county roads in Thurston County. Pender picked up around 3½ inches of rain from the storms.

June 11, 2004
Heavy rain caused flash flooding of several roads and Highway 77 across the County. Although rain amounts over the county were only one to two inches, it was the second consecutive night that rainfall of that magnitude fell. The rain washed out back roads between Pender and Thurston, and Highway 77 south of Winnebago was briefly closed by flood waters.

Dakota County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Countywide	03/07/1993	0000	Flood	N/A	0	0	500K
2 Jackson	07/16/1996	09:20 PM	Flash Flood	N/A	0	0	1.0M
3 Dakota City	07/02/1999	08:40 AM	Flash Flood	N/A	0	0	0
4 West Portion	05/17/2000	09:30 PM	Flash Flood	N/A	0	0	0
5 Hubbard	06/25/2000	12:00 PM	Flood	N/A	0	0	0
6 Willis	06/07/2002	06:50 PM	Flash Flood	N/A	0	0	0
7 South Sioux City	06/09/2003	08:10 PM	Flash Flood	N/A	0	0	0
8 South Sioux City	06/16/2004	10:00 AM	Flash Flood	N/A	0	0	0
9 South Sioux City	04/20/2005	05:00 AM	Flash Flood	N/A	0	0	0
10 Hubbard	10/04/2005	05:50 PM	Flash Flood	N/A	0	0	0
				TOTALS:	2	0	1.500M

March 7-11, 1993
Although only a damage claim of $500,000 is available, NCDC did not provide specific information. As a part of the unprecedented Great Midwest Flood of 1993, Dakota County witnessed flooding, just like most Nebraska counties and all counties in Iowa. However, since this damage report is prior to 1994, NCDC did not have specific details or damage amounts. The two deaths reported for this event are for the entire region and may not be specific to Dakota County.

July 16, 1996
Heavy rain of six to ten inches caused flash flooding of lowlands and creeks in northern and eastern Dakota County. Roads were closed by the flooding with damage occurring to some roads. Several motorists were stranded and had to be rescued during the early morning hours. Basement flooding was widespread, with resulting damage. Flooding of cropland may have damaged crops, but any damage caused by flooding could not be separated from extensive hail damage which occurred with the storm.

July 2, 1999
Rainfall of three inches in a half-hour flooded streets and basements in Dakota City. The amount of damage was not known.

May 17, 2000
Heavy rain caused flooding of streets and lowlands across western Dakota County.
June 25, 2000
Very heavy rain caused flooding of lowlands and roads, including part of Highway 35 which was closed for a while.

June 7, 2002
Heavy rain caused flooding of rural roads and lowlands along Elk Creek in the Willis unincorporated area, which is approximately 3½ miles west of Jackson on Highway 20.

June 9, 2003
Very heavy rain caused widespread flooding of streets and other low areas in South Sioux City. Several vehicles were stranded, but no damage estimate is available.

June 16, 2004
Heavy rain caused widespread street flooding in South Sioux City, stalling numerous vehicles. No damage estimate is available.
April 20, 2005
Runoff from heavy rain caused street flooding, including water covering a large part of Dakota Avenue in South Sioux City.

October 4, 2005
Heavy thunderstorm rain caused street flooding, but caused no damage.

Previous NRD Flood Mitigation Actions
One of the primary reasons that natural resources districts were created in the 1970s was to help with flood control. As a result, all NRDs around the state have initiated their own programs. The Papio NRD has gone the next step to help fund non-structural mitigation such as acquisition and demolition projects. The following is an exhaustive list of the different programs that the NRD administers, along with specific projects that have been completed within each – if known.

Flood Control
Urban Drainageway Program
This program provides technical and financial assistance to municipalities to control erosion, and/or flooding, along major urban drainageways. From 1984 to 2006, this program has been used to complete the projects in the table below.

Completion Date	Project Description	Cost Share Amount
1984	**Omaha** - Meadowlane Park Drainageway improvements	$ 80,000
1986	**Blair** - Cauble Creek grade stabilization structures	$ 70,000
1986	**Omaha** - Latvian Village Drainageway	$ 60,000
1987	**Ralston** - grade control structure in Wildwoode Park.	$ 43,715
1988	**Omaha** - Frederick Street Drainageway improvements	$ 800,000
1989	**Bellevue** - Betz Road Ditch improvements	$ 422,000
1989	**Omaha** - Cottner Street Drainageway, Phase 1	$ 70,000
1992	**Fort Calhoun** - Clay Street Drainageway	$ 60,650
1992	**Omaha** - Improvements to Hell Creek through Roxbury Park	$ 202,750
1994	**South Sioux City**-Westside Drainageway Project, phases 1-3	$ 410,000
1995	**Omaha** - Cottner Street Drainageway	$ 420,000

1996	**Omaha** - Meadowlane Park Drainageway	$	284,940
1997	**Omaha** - East Omaha Stormwater Detention Cell	$	114,900
1997	**Ralston** - Ralston Creek stabilization Project at 78th Street	$	133,000
1997	**Gretna** - Angus Street drainageway	$	37,800
1998	**Douglas County** - Hefflinger Park Drainageway	$	200,635
1998	**South Sioux City** - Eastside Drainageway Project	$	813,000
1999	**Omaha** - F Street Drainageway	$	126,000
1999	**Bellevue** - Brown River Drainageway	$	77,100
2000	**Ralston** - Ralston Creek Stabilization Project	$	500,000
2000	**LaVista** - Thompson Creek Stabilization Project	$	284,700
2000	**Fort Calhoun** - Eastside Drainageway Project	$	265,296
2000	**Elkhorn** - Ta-Ha-Zouka Park Drainageway	$	117,000
2001	**Omaha** - Rockbrook Creek Stabilization Project	$	266,000
2002	**LaVista** - Thompson Creek Project (west 84th Street)	$	72,000
2003	**Tekamah** - Tekamah Creek Stabilization	$	32,250
2004	**Elkhorn** - Greenbrier Park Drainageway	$	86,430
2004	**La Vista** - La Vista Falls Golf Course Channel	$	102,570
2004	**Omaha** - Regency Storm Sewer Stabilization	$	258,690
2005	**Elkhorn** - West Branch Phase 3	$	75,632
2006	**Papillion** - Halleck Park Drainageway	$	180,000
2006	**La Vista** - Thompson Creek Phase 5	$	174,000
2006	**Omaha Tribe** - Macy Stormwater Management	$	144,427
	Total All Projects:	**$**	**6,152,736**

District-Priority Watershed Flood Control

The Papillion Creek and Tributaries project originally sponsored by the U.S. Army Corps of Engineers has been supported by the NRD in several ways. Prior Soil and Water Conservation Districts and Watershed Boards which later merged to form the Papio NRD sponsored the original Watershed Work Plan for the Papillion Creek Watershed prepared in August 1966 with assistance from the USDA and State of Nebraska. This plan later lead to the development of a flood control plan by U.S. Army Corps of Engineers involving 21 proposed reservoirs. To date, seven of these reservoirs have been completed as detailed below.

The Watershed P.L. 566 Projects authorize the District to construct and maintain dam structures in watershed work plans and other written agreements with the USDA Natural Resources Conservation Service (NRSC). For example, the work plan for the Papillion Creek Watershed, prepared and administered by the NRCS, calls for 52 grade stabilization and sediment control structures to be built. To enable the NRD to carry out its obligations as the local sponsor, the NRD acquires land rights, easements, and right-of-way; provides for relocations; and the operates and maintains completed structures.

Under these programs, the dams and reservoirs that have been completed are:

- Corps-sponsored lakes like: Lake Zorinsky (DS 18), Cunningham Lake (DS 11), Standing Bear Lake (DS 16), Wehrspann Lake (DS 20), and Candlewood Lake (DS 17)
- Papio Creek and Tributaries Reservoirs like: Bennington Lake (DS 6) and Walnut Creek (DS 21)
- Turtle Creek watershed: 2 completed
- Southern Sarpy watershed: 0 completed
- New York Creek watershed: 0 completed
- Buffalo Creek watershed: 10 completed
- Papio Channel, Little Papio Channel Maintenance
- Tekamah/Mud Creek: 15 completed including Summit Lake
- Elm/Lonetree Creek near Decatur: 0 completed
- Silver Creek watershed in Burt County: 12 completed
- Pigeon/Jones Creek watershed in Dakota County: 6 completed

Flood Control Improvement Corridor Program

This program identifies reaches of streams which are targeted for improvement and offers a variety of techniques to allow the NRD to eventually improve them.

- Big Papillion Creek from Blondo Street to Fort Street
- West Branch of Papillion Creek from 96th Street to West Center Road
- South Branch of Papillion Creek from mouth to Highway 50

Previously improved reaches completed by the District or others include:

- Big Papillion Creek from "L" Street to W. Center Rd.
- Big Papillion Creek from W. Center Road to Blondo Street
- West Branch of Papillion Creek from Confluence to Papillion
- West Branch of Papillion Creek from "F" Street to W. Center Road

Future improvement corridors may include:

- West Branch of Papillion Creek from Papillion to Giles Road
- Big Papillion Creek from Blondo Street to Fort Street

Small Flood Control Structure Program

This program provides technical and financial assistance to landowners in the installation of small flood control structures within the Papillion Creek Watershed. An example of a flood control structure completed under this authorization is the Sachs-Palmer Dam. Criteria for Assistance are:

- The watershed for each structure shall be at least 500 acres.
- All projects shall be designed as high hazard flood control structures to contain the 100-year flood below the emergency spillway.
- Projects under this program shall have a total project cost of less than $500,000, such costs to include but are not limited to preliminary design, geotechnical investigations, final design and construction engineering, soils and materials testing and project construction.
- At least 75% of the applicant's property in the watershed shall have adequate land treatment.

Project Operation and Maintenance Assistance Program
The NRD will consider assuming the operation and maintenance for existing flood control levee projects, previously maintained by others, on a case-by-case basis. Examples of these projects are maintaining the Union Dike/Unnamed Dike at Valley; levees along West Branch Papillion Creek, Little Papillion Creek, and Big Papillion Creek; Corps of Engineers levees R-613 and R-616; Pigeon/Elk Creek levees in Dakota County; and tie-back levees from the Big Papillion Creek to higher ground at Mud Creek, Giles Creek, Whitted Creek, Big Elk Creek, and Thompson Creek.

Emergency Dike Protection, Fortification, Repair Assistance Program
This program provides technical and financial assistance on eligible projects where a flood control dike or levee is, at the discretion of the NRD, in imminent danger of failure.

Flood Mitigation and Management
Floodway Purchase Program
This program promotes the health, safety, and well-being of the public and reduces flood damages through the purchase of floodway lands and improvements.
The purposes are:

- To reduce future flood insurance and disaster assistance costs by removing repetitively and/or substantially damaged structures from flood risk areas.
- To provide an opportunity for owners of repetitively and/or substantially damaged structures to have those structures permanently removed from flood risk areas, and to reduce risk to life from flooding.
- To complement Federal, state and local efforts to restore floodplain values, protect the environment and provide recreational and open space uses.

The objective of this program is to provide a voluntary program whereby property in the floodway would be purchased, and whereby buildings in the floodway would be razed or relocated outside of the floodway, on a willing seller/willing buyer basis, without exercise of eminent domain. The NRD receives periodic requests to be bought out from owners of property in a floodplain/floodway, but the State and NRD have no consistent funding mechanism with which to complete these acquisitions.

Previous floodway acquisitions have taken place in the Holubs Place/Elbow Bend/Iske Park area of unincorporated Sarpy County in the Missouri River floodplain, Cole Creek floodplain of Omaha, Weircrest area of Omaha, Cauble Creek in Blair, Beacon View area of the Platte River floodway east of Ashland, and the 61st Street & Harrison Street area in LaVista.

Flood Mitigation Planning and Mapping Assistance Program
This program provides technical and financial assistance to governmental entities located within the NRD to help identify flood prone areas and to plan projects to reduce flood risk and damage. The Papio NRD is a Cooperating Technical Partner (CTP) with FEMA, and administers floodplain mapping and remapping projects through this program.

Criteria for Assistance are:

- Assistance in flood mitigation planning and mapping requires sponsorship by a city, town, village, county, municipality or other unit of local government with the authority and capability to carry out the Flood Mitigation Plan and/or adopt any new or revised National Flood Insurance Program (NFIP) Flood Hazard Studies and Maps.
- The Sponsor must participate in the NFIP and be in "good-standing" status.
- All Flood mitigation planning and floodplain mapping must conform with all federal, state and local laws, standards or guidelines.

The NRD has assisted with the non-federal cost-share of FEMA-funded (Flood Mitigation Assistance Program or Hazard Mitigation Grant Program) mitigation plans in Tekamah, Valley, and the Cole Creek watershed in Omaha.

The NRD currently administers the floodplain remapping for 50 miles of the West Papillion Creek and its Tributaries in Douglas County and Sarpy County (CTP funds – fiscal year 2004).

Ice Jam Removal Program

The General Manager may determine that flood waters impounded by an ice jam in the Platte River or Elkhorn River within the NRD boundary pose an imminent threat of flood damage, injury, or loss of life or property in an area intended to be protected by a NRD flood control project. In such cases, the General Manager may employ any qualified persons to remove the ice jam in order to release the impounded flood waters. The use of explosives or other techniques is authorized. During cold weather, the NRD monitors up to 12 sites where ice jams have been problematic in the past. The findings of this monitoring is uploaded to the ice jam monitoring website hosted by the Nebraska Department of Natural Resources and overseen by the Nebraska Emergency Management Agency. The General Manager may also request assistance from the Nebraska Emergency Management Agency with potential ice dusting.

Flood Plain Management Program

Technical assistance for flood plain management is given to all communities, counties and individuals in the NRD. Staff makes recommendations regarding development and improvements in flood plain areas. These recommendations are based on federal flood insurance maps, state regulations, and/or currently accepted flood plain management standards which cohere to wise uses of flood plain areas. Staff also deals with the general public on a day-to-day basis to determine the flood plain status of the individual's land or soon-to-be-acquired land.

Urban Stormwater Management Program

To promote the health, safety, and well-being of the public, it is the present and long range intent of the NRD to:

- Serve as a regional coordination and management agency for major urban drainage and flood control systems which are those systems that involve open channels where the drainage area is more than approximately 200 acres.
- Develop Urban Drainage Master Plans which define policies and outline plans for the development, financing, implementation and continued maintenance of urban drainage and flood control systems in each basin. This will be done with the assistance of and in consultation with other local governmental agencies.

- Expect and continue to review and comment on other local governmental subdivisions (cities, counties and Sanitary Improvement Districts) plans to continue to develop, finance, implement, operate and maintain urban drainage and flood control systems that involve enclosed conduits (storm sewers), road crossing and other similar appurtenant systems.
- Assume responsibility for major urban drainage and flood control systems in the District in accordance with the Urban Drainage Master Plan. For areas where no Urban Drainage Master Plan is currently available, the District will consider the planning, development, improvement, financing, implementation and continued maintenance of existing and proposed improvements to major urban drainage and flood control systems on an individual basis.
- Expect, concurrent with or prior to assumption of responsibility for an urban drainage and flood control system, that the local subdivision with regulatory responsibility and authority enact for existing and proposed urban development Sediment and Erosion Control ordinances and Stormwater Management ordinances that provide for District review and concurrence of basin development proposals to ensure that they comply with Urban Drainage Master Plans if the District is expected to assume responsibility for any portion of the development plan.

Flood Warning

Alert Floodwarning System

The Alert Floodwarning System has been installed in the Papio basin. This system consists of 17 combination rain and stream gauges and five individual rain gauges. Information collected by this system is transmitted to the National Weather Service office in Valley where it is stored on a computer and used by the National Weather Service. Through an interlocal agreement, the NRD maintains this system with the City of Omaha, Douglas County, Washington County, and Sarpy County. All parties help to share the cost of this maintenance. The National Weather Service, through this same agreement, has agreed to monitor the system and provide watches and warnings as well as forecasts based on the information provided by this system. The information stored on the computer is available to the Douglas County, Sarpy County, the City of Omaha, the Corps of Engineers, and the NRD through the internet and through telephone modems.

NRD staff communicates with emergency management agencies, law enforcement agencies, and the National Weather Service to help them provide the general public with advance warning prior to floods. First priority is given to NRD project areas. Field information on the status of flooding along project areas is provided to these agencies by the NRD staff. The agencies are expected to provide the NRD staff with information concerning upstream conditions and forecasted flood levels in project areas.

Stream Staff Gauge Program

Stream staff gauges have been placed by the NRD at various locations along the Platte River, Elkhorn River, and along the Papio Creeks, Springfield Creek, and Bell Creek, to aid in determining stream flows and flood stages. The NRD maintains these gauges. During high water events, staff, spotters for the National Weather Service, and others make visual observations of these gauges to document stream stages and assist in flood forecasting.

Rain Gauge Program

The NRD maintains a rain gauge network by supplying individual cooperators with rain gauges and data books to develop long-term rainfall data and assist in flash flood warning. During period of intense rainfall, the National Weather Service and the news media can contact cooperators and receive rainfall information. This network also allows the NRD to evaluate emergency operations needs while providing hydrologic data for future use.

Education and Outreach

Information and Education Program

Informing the public is done to provide them with accurate information on projects and programs and to develop an awareness and concern for natural resource conservation and management. Major support activities include: program brochures, newsletters, education programs, teacher scholarships, a speakers bureau, news releases, internet websites, and a volunteer program.

2.23 Probability of Future Flood Events

It is certain that the Papio NRD area will continue to be impacted by flood events of all three major types: riverine floods, flash floods, and ice jams.

2.24 Vulnerability Assessment of the Flood Hazard

The US Army Corps of Engineers completed the vulnerability assessment portion of this report. Community-specific flood vulnerability information is given for each community in **Appendix E**. As shown in **Appendix A**, the Corps was able to find 1,600 structures in the floodplain in the Papio NRD and was able to determine assessed valuations for 616 of them, which totals $105,641,665.

2.25 Potential Flood Mitigation Measures

Objective 1: Determine valuation information for the remaining structures in the vulnerability assessment in order to have a more complete concept of the NRD's true total flood risk.

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

Objective 2: Undertake flood control projects under the NRD's authority

- Action 2.1: Continue to utilize existing programs for the NRD's various flood control programs. Specific proposed projects for flood control reservoirs are Site 13 dam, Site 1, Site 3C, Pigeon/Jones Site 15. These sites will need to go through a rigorous process to determine project feasibility before they are constructed.

Objective 3: Mitigate losses for floodprone buildings

- Action 3.1: Operate as non-federal cost-share partner for FEMA-funded or other sponsored nonstructural mitigation projects such as buyout/removal and elevation. All communities and jurisdictions will be considered if there is need; however, higher priority will be given to structures in an identified floodway and for structures which are

listed on FEMA's National Flood Insurance Program repetitive loss list. Specifically targeted areas are: Elbow Bend/Iske Park in unincorporated Sarpy County in the Missouri River floodway, King Lake in unincorporated Douglas County in the Elkhorn River floodway, Beaconview in unincorporated Sarpy County in the Platte River floodway, Cole Creek watershed in Omaha, Weircrest area of Omaha, 61st & Harrison area of LaVista, and properties in the Bell Creek floodplain in Arlington.

- Action 3.2: Continue to operate the NRD's ice jam monitoring and removal program

Objective 4: Provide floodplain management technical assistance within the NRD

- Action 4.1: Continue to provide assistance under the NRD's authority

Objective 5: Provide flood warnings and stream and rain data for the use of the NRD, National Weather Service, county emergency management agencies, and others

- Action 5.1: Continue to operate the NRD's Alert Floodwarning System and other stream or rain monitoring systems

GOALS: 3) Increase Public Education

Objective 6: Increase awareness of citizens in the Papio NRD about natural hazards and what can be done to reduce vulnerability to severe events

- Action 6.1: Continue to use existing NRD education and outreach programs to educate and inform the public about natural hazard mitigation options and what the NRD is doing in this area.
- Action 6.2: Explore options of working with the emergency management agencies in the Papio NRD area to expand natural disaster educational opportunities.

2.30 TORNADO

2.31 Background

Tornadoes and high winds have been a way of life in Nebraska since the time of pioneers in the 1800s. With its location at the frequent convergence area for Canadian, Gulf of Mexico, and Pacific air masses, Nebraska is located in a part of the United States where tornadoes are a common occurrence. Nebraska is ranked fifth in the nation for the number of tornadoes, but 23rd in number of tornado fatalities and 24th in tornado injuries. Nebraska averages 39 tornadoes per year, with the most recorded tornadoes being 102 in 1999. All 93 counties in Nebraska have had tornadoes since 1950. The peak month for tornadoes is June, and 78% of all Nebraska tornadoes have occurred in May through July. In terms of timing, 71% of all Nebraska tornadoes have occurred between 3:00 and 9:00 pm, and 53% of all Nebraska tornadoes between 4:00 and 8:00 pm.

The intensity of tornadoes is measured by the Fujita Scale, which is shown by the letter "F" followed by a number from zero to five. The higher then number, the more intense the tornado, as witnessed by the extent of damage left by the tornado. Since the Fujita Scale is determined by actual damage, the wind speeds for each are not as important.

F0 – Very Weak (less than 73 mph)
F1 – Weak (73 to 112 mph)
F2 – Strong (113 to 157 mph)
F3 – Severe (158 to 206 mph)
F4 – Devastating (207 to 260 mph)
F5 – Incredible (261 to 318 mph)

Although F1 storms are classified as "weak," F1 winds can reach over 112 miles per hour and cause considerable damage, injury, or death.

2.32 Tornado History

A town called St. John's City was established in 1856 in present-day Dakota County and was one of the earliest settlements along the Missouri River. In addition to being prone to flooding from the unruly Missouri, a tornado destroyed nearly all of the buildings in town. The people who stayed to resettle in the area decided to move the town south, which became known as the town of Jackson.

Reports indicate that most of the entire Village of Herman was leveled by a tornado on June 13, 1899. The downtown was completely demolished, and 13 people were killed.

A tornado that destroyed the Tekamah's opera house on June 1, 1904. Built in 1884, this building was used for general entertainment of the citizens, including political debates, plays, commencement exercises, revival meetings, dances, and roller skating parties. The tornado destroyed the building and it was not rebuilt.

The Easter Tornado of 1913 caused major damage in Millard, Omaha, and other small communities in today's metropolitan area. In this tornado, 191 people were killed, 2000 homes destroyed, and $10 million in property damage was recorded (1913 dollars). Damage and injuries were also reported in Ralston and Valley from this storm, but surely it impacted other communities as well.

The second historic tornado to hit Tekamah took place in 1930. A photograph from the Nebraska State Historical Society shows widespread destruction with damage consistent with an F3 or F4 tornado. However, damage and casualty information for both tornadoes was not given, and no additional references to this tornado were found.

An F4 tornado impacted Omaha on May 6, 1975. Good fortune, a storm spotting network, and an advanced and adequate warning kept the death toll from exceeding three persons. A ten-mile swath was ground through the heart of the City. 2000 homes, 120 businesses, and many public facilities were destroyed. The final damage estimate was $200 million and an estimated 2,600 persons were injured.

On August 17, 2001, an F2 tornado destroyed at least ten houses and damaged several more in Jackson. The town's school, church, and telephone company building were heavily damaged. Three injuries were reported from this event, and property damage was estimated at $3 million. This tornado resulted in federal disaster number FEMA-1394-DR-NE.

By county, tornado statistics are:

	Number of Tornadoes	Tornado Fatalities
County	(1950 to 2004)	(1916 to 2004)
Sarpy	30	2
Douglas	12	3
Washington	12	0
Burt	12	4
Thurston	13	3
Dakota	8	2

Tornado-specific information for each county is as follows:

Sarpy County

DATE	TIME	Deaths	Injured	F-Scale
MAY 13, 1957	1845	0	0	F1
MAY 16, 1957	1200	0	0	F1
JUN 06, 1971	2130	0	0	F0
MAY 06, 1975	1533	0	15	F4
MAY 07, 1988	2139	2	1	F2
AUG 13, 1952	1900	0	20	F4
JLY 03, 1953	1530	0	0	F1
JLY 18, 1956	1900	0	0	F1
JLY 30, 1956	1530	0	0	F1
JUN 15, 1957	2100	0	0	F1
JUN 21, 1957	1852	0	0	F1
AUG 05, 1958	1730	0	0	F0
MAY 02, 1959	1315	0	0	F1
MAY 04, 1959	1630	0	1	F1
MAY 20, 1959	2100	0	0	F2
MAY 06, 1964	0550	0	0	F2
MAY 23, 1964	1900	0	0	F1
MAY 22, 1966	1948	0	1	F2
MAY 23, 1971	1515	0	0	F1
JLY 03, 1973	2130	0	0	F1
MAY 06, 1975	1500	0	0	F0
MAY 04, 1977	1615	0	0	F1
MAY 26, 1977	1420	0	0	F1
MAY 29, 1980	1945	0	0	F1
MAY 07, 1988	2125	0	0	F2
MAY 18, 1989	1720	0	0	F0
JUN 07, 1989	1705	0	0	F0
JUN 07, 1989	1727	0	0	F0
JUN 12, 1993	0215	0	0	F0
APR 11, 2001	1115	0	0	F0

Douglas County

DATE	TIME	Deaths	Injured	F-Scale
MAY 12, 1956	2200	0	0	F1
MAY 13, 1957	1900	0	0	F1
MAR 30, 1967	1845	0	0	F1
JUN 24, 1968	1840	0	0	F0
AUG 18, 1968	1745	0	0	F3

JUN 06, 1971	2130	0	0	F0
JUN 07, 1972	1616	0	0	F0
MAR 27, 1975	1645	0	4	F2
MAY 06, 1975	1535	3	118	F4
JUN 26, 1976	1645	0	23	F1
MAY 07, 1988	2152	0	0	F2
APR 29, 1991	1215	0	0	F0

Washington County

DATE	TIME	Deaths	Injured	F-Scale
JUN 07, 1953	1845	0	1	F2
JUN 04, 1955	2125	0	0	F0
MAY 10, 1956	2000	0	0	F1
MAY 30, 1958	0300	0	0	F1
JUN 24, 1968	0215	0	0	F1
AUG 20, 1977	1950	0	0	F1
APR 08, 1978	0340	0	0	F1
AUG 02, 1990	1535	0	0	F0
AUG 02, 1990	1555	0	0	F1
JUN 20, 1996	2430	0	0	F1
APR 08, 1999	1248	0	0	F0
APR 22, 2001	2457	0	1	F1

Burt County

DATE	TIME	Deaths	Injured	F-Scale
JLY 15, 1950	1730	0	33	F4
JUN 15, 1960	2000	0	0	F2
MAY 06, 1964	0530	0	0	F1
MAY 22, 1966	1900	0	0	F1
JUN 13, 1967	2000	0	0	F0
JLY 07, 1977	0310	0	0	F1
JUN 17, 1984	1800	0	0	F1
JUN 17, 1984	1814	0	0	F1
MAY 27, 1991	2345	0	2	F3
MAY 28, 1991	0030	0	0	F2
JUN 16, 1992	2200	0	0	F2
JUN 18, 2001	2436	0	0	F0

Thurston County

DATE	TIME	Deaths	Injured	F-Scale
JUN 17, 1954	2015	0	0	F3
AUG 25, 1954	0330	0	0	F0
JUN 14, 1967	0130	0	0	F2
JLY 01, 1973	2115	0	0	F1
MAY 25, 1975	1900	0	0	F0
MAY 25, 1975	1900	0	0	F0
JLY 07, 1977	0230	0	0	F1
JLY 30, 1977	0130	0	0	F1
MAY 28, 1978	2050	0	0	F1
MAR 13, 1990	2201	0	0	F1
AUG 26, 1993	2127	0	0	F1
JUN 23, 1998	2415	0	0	F0
JUL 25, 2002	0325	0	0	F0

Dakota County

DATE	TIME	Deaths	Injured	F-Scale
MAY 26, 1955	1700	0	0	F1
MAY 08, 1965	1830	0	0	F1
JUN 15, 1970	2225	0	0	F2
JLY 28, 1986	1815	0	1	F3
JUN 24, 1987	1741	0	0	F0
MAY 27, 1995	1638	0	0	F0
JUL 16, 1996	2200	0	0	F0
AUG 17, 2001	1645	0	0	F2

Previous NRD Tornado Mitigation Actions

Tornado preparedness, response, and mitigation are primarily responsibilities of county and region emergency management agencies in the area. For this reason, the Papio NRD has not assisted with or completed tornado mitigation projects.

2.33 Probability of Tornado Events

Although they do not necessarily occur every year, history shows that tornadoes in the Papio NRD are common and that they should be expected.

2.34 Vulnerability Assessment of the Tornado Hazard

Every structure in the Papio NRD is at risk to tornadoes. According to the Nebraska Department of Property Assessment and Taxation, this represents a value of $40,290,231,815. **Appendix E** includes the structural inventories and vulnerability information for the communities participating in this plan.

2.35 Potential Tornado Mitigation Measures

Unlike floods, tornadoes and high winds do not occur in a defined area – the entire community is vulnerable. Therefore, instead of mitigation, the primary focus should be on warning and response. But there are projects that the city and homeowners can undertake to reduce the damage from these events.

Goal 1: Increase Public Safety from Tornadoes

The locations of tornado sirens in the communities participating in this plan are given in **Appendix E**. On these maps, a series of buffer zones (1/2 mile, 1 mile, 1.5 miles) is provided to show different distances from these sirens. A half-mile area (green on the maps) is a very conservative estimate for adequate hearing distance. However, tornado sirens are meant for outdoor warning only and are not designed to wake up people while they are sleeping, alert motorists who have their windows rolled up and the radio playing, or alert people who are in their houses with appliances on or with radios or televisions playing. In addition, the weather that is necessary for these sirens to function may have loud wind and thunder noise which may affect how the sirens are heard. The decibel level of the existing sirens should be identified and a maximum range of the sirens should be determined to see if there is adequate coverage of the

entire city. By city statute, new sirens should be added as new development takes place which is outside or on the edge of the existing tornado siren coverage.

The same is true for tornado shelters. There is usually a concentration of potential public buildings which could be used as shelters in the downtown area of a community. However, for homes without basements, mobile homes, and businesses, there is usually no recognized shelter. Major employers may have designated tornado safe rooms for their workers, but all businesses and high-density residential concentrations would benefit from designating and publicizing a shelter or other existing structure which meets tornado safe room specifications. A private consultant may be required to complete this sort of assessment.

Objective 3.1: Increase safety of students during daytime hours
- Action 3.1.1: Pursue a federal grant to retrofit public school buildings with a tornado shelter or with higher-designed windows and doors. FEMA publication #361 should be used for constructing public shelters.

Objective 3.2: Increase safety of the general public in the business district and in parts of communities with few shelter options
- Action 3.2.1: Identify and designate tornado shelters, publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building.
- Action 3.2.2: Construct tornado shelters for mobile home concentrations or in other locations with vulnerable construction.
- Action 3.2.3: In areas especially prone to damaging high winds, "hurricane straps" and better-designed windows and doors can be used to attach the roof rafters to the ceiling supports of the highest floor. This would need to be done as a building retrofit and would not be expensive. New construction can use this building technique very cheaply.
- Action 3.2.4: Offer information to home owners about tornado safe rooms to be constructed as a part of their homes.

Objective 3.3: Ensure adequate outdoor warning siren coverage
- Action 3.3.1: Perform assessment of the tornado siren coverage for communities, add sirens if found to be deficient.
- Action 3.3.2: Codify regulations that require additional tornado sirens as development occurs outside of current coverage areas.

Objective 3.4: Oversee adequate indoor warning coverage
- Action 3.4.1: Purchase NOAA weather radios for critical facilities (i.e., public schools)
- Action 3.4.2: Purchase or encourage non-public critical facilities (i.e., nursing homes) to purchase weather radios.
- Action 3.4.3: Educate a community's businesses about purchasing additional warning systems, especially in manufacturing facilities where it may not be possible to hear the outdoor sirens.

Goal 3: Increase Public Education

In communities that have not seen a tornado or high wind events recently, there is the danger that residents will not know what to do when they happen.

Objective 3.5: Help residents know what to do in case of a tornado warning
- Action 3.5.1: Residents should be made aware that tornadoes are possible in their

community. They should know where to go in the event of a tornado (i.e., to a shelter or internal room/basement in their houses).

- Action 3.5.2: Educate homeowners about how to maintain trees on their property since they are responsible for them.
- Action 3.5.3: Have available information to educate homeowners about types of desired trees for planting on private property. Information should include: insect susceptibility, potential disease problems, blossom or seed characteristics, cold weather hardiness, and other items.

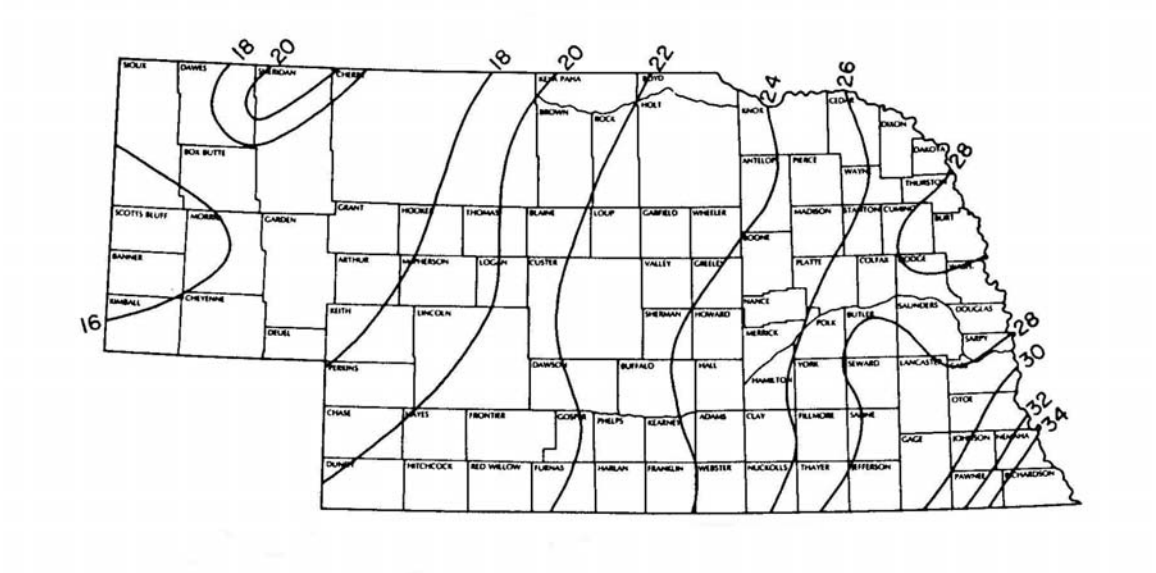
2.40 DROUGHT

2.41 Background

Figure 2 is the isohyet map of the State of Nebraska which shows the average rainfall across the State. Eastern Nebraska receives more abundant rainfall than the west, and in the Papio NRD area that equals an average rainfall is 28-32 inches per year. In average years this represents enough rainfall to prevent drought; however, it is during successive years of below-average rainfall that droughts do impact this area.

Confounding the discussion of drought is the fact that there are different definitions of drought: meteorological drought, agricultural drought, and hydrological drought. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. For example, some definitions of meteorological drought identify periods of drought on the basis of the number of days with precipitation less than some specified threshold.

Figure 2 – Nebraska Isohyet Map
(Average Annual Rainfall in Inches)



Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per hectare and a reduction of final yield. However, if topsoil moisture is sufficient for early growth requirements, deficiencies in subsoil moisture at this early stage may not affect final yield if subsoil moisture is replenished as the growing season progresses or if rainfall meets plant water needs.

The three different definitions all represent significant things in Nebraska. A meteorological drought is the easiest to determine based on rainfall data and is an easier drought to monitor from rain gauges and reports. An agricultural drought represents difficulty for Nebraska's agricultural-based economy and is also relatively easy to monitor based on crop viabilities for different regions. A hydrological drought means that stream and river levels are low, which also has an impact for surface water and ground water irrigators. In addition, in-stream discharges that fall below a pre-required level also place the State in a regulatory difficulty with US Fish and Wildlife and with neighboring states over cross-border flowage rights. Hydrologic drought is somewhat more difficult to monitor since it requires some field verification of stream levels.

Nebraska is fortunate to have the National Drought Mitigation Center on the campus of the University of Nebraska in Lincoln. The NDMC provides drought monitoring and technical assistance to all areas of the world.
NDMC's website is found at: http://www.drought.unl.edu/.
Specific drought impacts by county are recorded at: http://droughtreporter.unl.edu/.

The impacts of drought can be categorized as economic, environmental, or social. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human

and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected.

Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects. Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well.

2.42 Drought History

In addition to differing definitions, there is also some debate about whether or not an area has experienced or is currently experiencing a drought. Certainly the City of Omaha has experienced periods of time when lawn watering had to be voluntarily curtailed in order to maintain an adequate water reserve. However, although these periods may have witnessed below-average rainfall, the impacts were not felt much further than an inconvenience to homeowners. There have been no instances of drought which have caused drastic impacts in the Papio NRD area to the extent that land use regulations or emergency actions have had to be used.

Previous NRD Drought Mitigation Actions

Other than monitoring, there is precious little that can be done to mitigate a drought. As a result, extensive drought monitoring networks have been established. The purpose of monitoring is to see that a drought is indeed happening so that planners are then able to take appropriate actions to stem the impacts before they reach crisis level.

The Papio NRD participates in programs which help with drought monitoring. The NRD maintains a rain gauge network by supplying individual cooperators with rain gauges and data books to develop long-term rainfall data. This network also allows the NRD to evaluate emergency operations needs while providing hydrologic data for future use. The Papio NRD is also involved in the Nebraska Rainfall Assessment and Information Network. In NeRAIN, the Nebraska Natural Resources Districts, Nebraska Department of Natural Resources, and other water-focused organizations, analyze and document data gathered by volunteers. The data will provide important daily decision-making information for agriculture, industry, home water use, utility providers, insurance companies, resource managers, and educators.

2.43 Probably of Drought Events

It is probable that a drought will impact the Papio NRD area in the future.

2.44 Vulnerability Assessment of the Drought Hazard

Due to the nature of a drought and the uncertainty about when it begins and ends, a vulnerability assessment is equally difficult to ascertain. One of the biggest drought impacts that could happen would be to a community's water system intake being rendered useless by declining water levels in a hydrological drought. The entire population in the Papio NRD area is theoretically at-risk for a drought. However, there is a disparity of risk between rural and urban areas. Most urban areas have water system in place which allows for adequate distribution of water, even in times when drought conditions prevail. Rural areas are more dependent on single-site water wells. In addition, since water is the economic lifeblood of agriculture in these areas, there is a much greater economic vulnerability to these areas. Since relevant drought impacts are more community-specific than area-based, drought issues are chronicled in the community reports found in **Appendix E**.

2.45 Potential Drought Mitigation Measures

The main drought mitigation measures can be grouped into five main categories: legislation/public policy, water supply augmentation, demand reduction/water conservation programs, emergency response programs, and drought contingency plans.

For legislation/public policy, some action items could include:

- Prepare position papers for legislature on public policy issues
- Examine statutes governing water rights for possible modification during water shortages
- Pass legislation to protect in-stream flows
- Pass legislation providing guaranteed low-interest loans to farmers
- Impose limits on urban development

Water supply augmentation:

- Issue emergency permits for water use
- Provide pumps and pipes for distribution
- Propose and implemented program to rehabilitate reservoirs to operate at design capacity
- Undertake water supply vulnerability assessments
- Inventory self-supplied industrial water users for possible use of their supplies for emergency public water supplies
- Inventory and reviewed reservoir operation plans

Demand reduction/water conservation programs:

- Established stronger economic incentives for private investment in water conservation
- Encouraged voluntary water conservation
- Improved water use and conveyance efficiencies
- Implemented water metering and leak detection programs

Emergency response programs:

- Establish alert procedures for water quality problems
- Stockpile pumps, pipes, water filters, and other equipment
- Establish water hauling programs for livestock
- List livestock watering locations
- Establish hay hotline

- Fund water system improvements, new systems, and new wells
- Fund drought recovery programs
- Lower well intakes on reservoirs for rural water supplies
- Extend boat ramps and docks in recreational areas
- Issue emergency irrigation permits for using state waters for irrigation
- Create low-interest loan and aid programs for agricultural sector
- Create drought property tax credit program for farmers
- Establish a tuition assistance program for farmers to enroll in farm management classes

Drought contingency plans:

- Establish statewide contingency plan
- Recommend that water suppliers develop drought plans
- Evaluate worst-case drought scenarios for possible further actions
- Establish natural hazard mitigation council

Funding sources and potential cost: There is a general lack of funding for drought mitigation projects. Most projects that are completed are based on crisis need, so federal grants with application periods are not frequently used. Cost would vary greatly depending on scope and type of project.

2.50 DAM FAILURE

2.51 Background

Many of Nebraska's communities were founded due to their proximity to water resources. Often, these streams or rivers later needed a dam for flood control or a reservoir for a constant water release. The Nebraska Department of Natural Resources performs annual inspections on all high-hazard dams in the State. A high-hazard dam is one where a large discharge and/or breach of the dam could potentially lead to downstream loss of life. High-hazard dams are designed to the Probable Maximum Precipitation event, which is typically three or four times the rainfall expected from a 500-year event.

Figure 3 shows the locations of the high hazard dams in the Papio NRD boundary, which are detailed in the table below.

County	Dam Name	Stream	Closest Community	Year Completed
Dakota	Hubbard Dam	Pigeon Creek, Jones Creek	Hubbard	2004
Burt	Tekamah-Mud Creek 22-A	Tekamah Creek, Mud Creek	Tekamah	1978
Burt	Tekamah-Mud Creek 5-A	Tekamah Creek, Mud Creek	Tekamah	1980
Washington	Lake Arrowhead	Long Creek	Rural Blair	1972
Douglas	Lonergan Dam	Little Papillion Creek	Omaha	1968
Douglas	Boys Town Dam #2	Big Papillion Creek	Omaha	1968
Douglas	Legacy Dam	Boxelder Creek	Omaha	1968
Douglas	Candlewood Dam	Big Papillion Creek	Omaha	1973
Douglas	Boys Town Dam #1	Hell Creek	Omaha	1947
Douglas	Standing Bear Lake*	Big Papillion Creek	Omaha	1973

Douglas	Cunningham Lake*	Little Papillion Creek	Omaha	1974
Douglas	Zorinsky Lake*	Boxelder Creek	Omaha	1983
Douglas	Indian Creek Golf Course 1	West Branch Papio Creek	Rural Elkhorn	1996
Douglas	Indian Creek Golf Course 2	West Branch Papio Creek	Rural Elkhorn	1996
Douglas	Bennington Lake (Site 6)	Big Papillion Creek	Bennington	2000
Douglas	Bennington Lake Basin 2	Big Papillion Creek	Bennington	2002
Douglas	Sachs-Palmer Dam	N. Branch West Papio Creek	Rural Elkhorn	2002
Douglas	Zorinsky Basin 3	Boxelder Creek	Omaha	2002
Sarpy	Papio Creek S-32	Big Papillion Creek	Bellevue	1970
Sarpy	Wehrspann Lake*	South Branch Papio Creek	Omaha	1983
Sarpy	Thompson Creek Project	Big Papillion Creek	LaVista	1986
Sarpy	Papio Dam Site 21	Walnut Creek	Papillion	1996
Sarpy	Lakewood Villages Upper Dam	Big Papillion Creek	Bellevue	1998
Sarpy	Lakewood Villages Lower Dam	Big Papillion Creek	Bellevue	1998
Sarpy	Hanson Lake Dam	Platte River	Hanson Lakes	2002

* Denotes dams built by or in partnership with the US Army Corps of Engineers

2.52 Dam Failure History

In the development of this mitigation plan, no record could be found of a dam failure in the last 40 years.

Previous NRD Dam Failure Mitigation Actions

Through its maintenance programs, the Papio NRD performs routine inspections to significant dams in the NRD. If dams are owned by the NRD, then any repairs needed are performed.

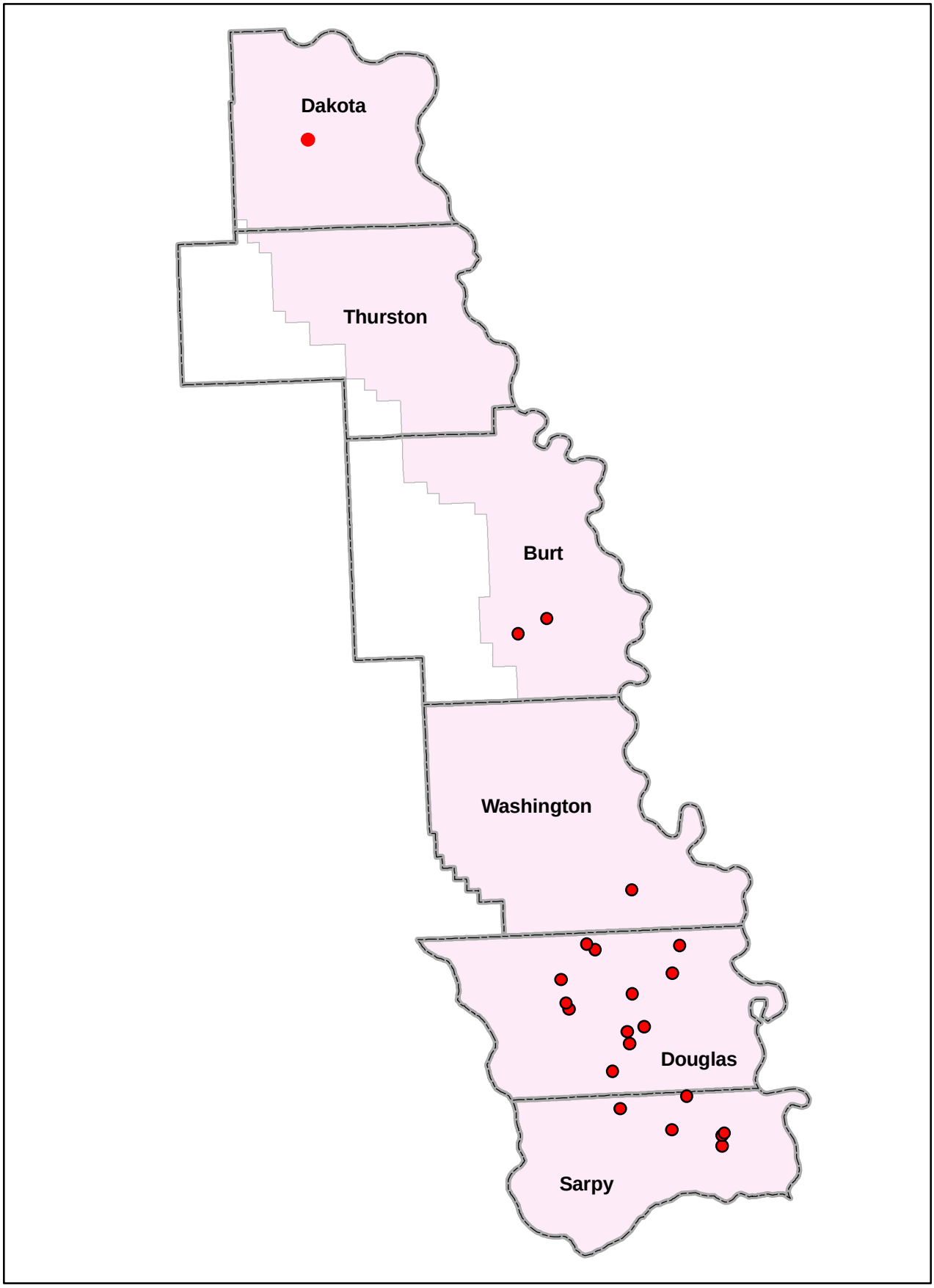
2.53 Probability of Dam Failures

There is a low probability of dam failures in the Papio NRD. This is due to the routine inspections and regular maintenance and because the dams are designed to the Probable Maximum Precipitation level.

2.54 Vulnerability Assessment of the Dam Failure Hazard

Dam breach-routing inundation paper maps have been completed for the Emergency Action Plan required for each high-hazard dam. These maps are kept on-file at the Dam Safety Division of the Nebraska Department of Natural Resources. Since the maps are of public record, they have been digitized for this report and are included in **Appendix D**. Also in the Emergency Action Plan, there is a requirement to determine the anticipated population that would be impacted by a dam breach. To do this, the engineering firm which oversees the maintenance of the dam has provided the routing map, and either the engineer or the NDNR has provided an estimation of the impacted population. When NDNR determines the impacted population, it compares the inundation map with the most recent Census information. For all impacted population estimates in this report, the 2000 Census information has been used. It is important to note that the figures noted below represent the total population at risk below the dam. The Loss of Life column is taken from NDNR records on work in conjunction with the Department of Homeland Security. Since populations further away will have more time to evacuate, and 90-minute flowage rate cut-off for areas downstream was used. By high hazard dam, the estimated impacted population is:

Figure 3
NRD High Hazard Dams



Dam Name	Population	Casualties
Hubbard Dam	70	35
Tekamah-Mud Creek 22-A	394	197
Tekamah-Mud Creek 5-A	913	60
Lake Arrowhead	10	5
Lonergan Dam	0*	0
Boys Town Dam #2	279	140
Wiebe Dam (Legacy)	5	3
Candlewood Dam	842	131
Boys Town Dam #1	775	176
Standing Bear Lake	477	99
Cunningham Lake	1474	81
Zorinsky Lake	1994	257
Indian Creek Golf Course 1	0	0
Indian Creek Golf Course 2	0	0
Bennington Lake (Site 6)	5653	53
Bennington Lake Basin 2	0	0
Sachs-Palmer Dam	18	9
Zorinsky Basin 3	0	0
Papio Creek S-32	547	274
Wehrspann Lake	1722	72
Thompson Creek Project	615	308
Papio Dam Site 21	0	0
Lakewood Villages Upper Dam	5	3
Lakewood Villages Lower Dam	5	3
Hanson Lake Dam	379	N/A

* = Primary hazard is to breaching downstream dam

Significant Hazard and Low Hazard dams have no State statutes requiring breach inundation areas and potential impacted population. As a result, this information has not been collected and will not be collected in the future unless a legislation requires it. However, a list of these dams and the population centers and critical facilities impacted by a potential breach will be included in the next update of this plan.

2.55 Potential Dam Failure Mitigation Measures

With the routine inspections and maintenance requirement, it is believed that all mitigation measures are being performed that can be performed.

Objective 1: Determine impacted population centers and critical facilities which could be inundated or otherwise impacted by a dam breach from Significant Hazard and Low Hazard dams.

2.60 FUTURE DEVELOPMENT AND HAZARD VULNERABILITY

Future development is not a primary concern of the Papio NRD since development decisions are made at the local level. When possible, future development plans are shown for each participating community in **Appendix E**.

Chapter 3 – Public Participation on Plan

The Nebraska Department of Natural Resources is the lead agency in the planning issues. All of the meetings were open to the public and noticed.

Present at the initial public meetings on August 3, 4, 24, and 31, 2005, were representatives from the US Army Corps of Engineers, Nebraska Department of Natural Resources, Papio-Missouri River Natural Resources District, County Emergency Management personnel, community elected officials, and many citizens. See the sign-in sheets and newspaper article in **Appendix C** for documentation.

In place of a second public meeting, this plan used the public input system available at the local level through the public hearing process. Local governments were notified by letter from NDNR of the projects identified by their community representatives in the initial public meeting. Letters were also sent to the emergency management agencies for Douglas County and Sarpy County for additional review in the Omaha metropolitan area. See **Appendix C** for copies of these letters. In the letter, communities and reviewers were asked if the projects listed were still an adequate representation of their hazard mitigation goals. In addition, local governments were also requested to prioritize their projects. The adoption by each participating community took place after the respective city councils, village boards, or county boards had worked through the public hearing process.

To fulfill the adjacent jurisdictions review requirement, the initial draft of the Papio NRD plan was posted on the website of the Nebraska Department of Natural Resources (NDNR). Then letters (included in **Appendix C**) were sent to all surrounding natural resources districts, requesting that they review the document and provide comments back to NDNR within one month. Letters were sent to: Lewis and Clark NRD (based in Hartington, NE), Lower Elkhorn NRD (Norfolk), Lower Platte North NRD (Wahoo), and Lower Platte South NRD (Lincoln).

Steve McMaster, Water Resources Planner for the Nebraska Department of Natural Resources, wrote this plan. The draft plan was sent to the Papio NRD Board for review at its May 10, 2006, meeting for prioritization of mitigation alternatives and to provide comments. The NRD Board was then requested to adopt the plan at their meeting on May 24, 2006. Documentation showing the adoption at the NRD level is given as the first page of this report. Work on the communities participating in the plan was still in progress at the time that the NRD Board adopted the plan. Once all communities have replied with comments and have adopted their individual portions of the plan, a completed **Appendix E** will be submitted to FEMA. Documentation of plan adoption is given in **Appendix F**.

Subsequent evaluations and updating of the plan will involve public display advertisements in the local newspaper or other public notices. The plan will be reviewed and revised as necessary every five years or after a Federally-declared disaster.

Plans and Other Information Used in the Development of this Plan

Village of Arlington Flood Insurance Study, FEMA. July 1980.
Information: Flood history, boundary, and statistics

City of Blair Flood Insurance Study, FEMA. July 17, 1995.
Information: Flood history, boundary, and statistics

City of Dakota City Flood Insurance Study, FEMA. March 16, 1981.
Information: Flood history, boundary, and statistics

City of Elkhorn Flood Insurance Study, FEMA. February 1979.
Information: Flood history, boundary, and statistics

City of Omaha Flood Insurance Study, FEMA. September 17, 1997.
Information: Flood history, boundary, and statistics

City of Ralston Flood Insurance Study, FEMA. November 1979.
Information: Flood history, boundary, and statistics

City of South Sioux City Flood Insurance Study, FEMA. February 1979.
Information: Flood history, boundary, and statistics

City of Tekamah Flood Insurance Study, FEMA. August 1981.
Information: Flood history, boundary, and statistics

City of Tekamah Flood Mitigation Plan, Nebraska Department of Natural Resources.
Information: Flood history, mitigation options, structural inventory

City of Valley Comprehensive Plan.
Information: Future development areas

City of Valley Flood Insurance Study, September 1979.
Information: Flood history, boundary, and statistics

Flood Plain Study, Platte River, Missouri River to Louisville, Nebraska, Nebraska Natural Resources Commission. November 1975.
Information: Flood history and statistics

Flood Proofing: How to Evaluate Your Options, U.S. Army Corps of Engineers, National Flood Proofing Committee. July 1993.
Information: Flood mitigation options and evaluation strategies

Flood Proofing Performance; Successes and Failures, U.S. Army Corps of Engineers, National Flood Proofing Committee. December 1998.
Information: Floodproofing mitigation options

National Arbor Day Foundation – Tree City USA website located at:
http://www.arborday.org/programs/treeCityUSA.cfm
Information: Tree City USA information

National Climate Data Center searchable severe weather database located at:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
Information: All-hazard statistics

National Flood Insurance Program, Community Rating System Coordinator's Manual, July 1994.
Information: CRS point-earning activities

Nebraska flood data, Nebraska Department of Natural Resources spreadsheet.
Information: Historic flood events in Nebraska

Our Town Nebraska ----- "Nebraska…Our Towns" Taylor Publishing, Dallas, TX. 1990.

Sarpy County Flood Insurance Study, FEMA. January 19, 1995.
Information: Flood history, boundary, and statistics – LaVista, Papillion, Sarpy County, Springfield

Village of Homer Flood Insurance Study, FEMA. June 18, 1996.
Information: Flood history, boundary, and statistics

Village of Waterloo Flood Insurance Study, FEMA. February 19, 1987.
Information: Flood history, boundary, and statistics

Washington County Flood Insurance Study, FEMA. May 16, 1995.
Information: Flood history, boundary, and statistics

Chapter 4 – Implementation

The Papio NRD will implement this plan by the methods outlined in this chapter. In addition to a positive benefit-cost ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns, and public support. Projects sponsored for implementation by the Papio NRD or by a participating community will follow a public process.

Determining which projects should be submitted for funding will be based on a FEMA-approved cost-benefit method. This means that proposed projects would need to be reviewed for cost effectiveness with the assistance of state emergency management or floodplain management personnel. In addition to a positive cost-benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns, and public support.

At its discretion, the Papio NRD may choose to not implement any of the proposed mitigation projects at this time with the realization that future events may change this stance as well as the prioritization of projects.

The Papio NRD Board reviewed the following projects for a recommendation on which projects should receive the highest priority. The Papio NRD is responsible for making the final decision on which projects are submitted to the appropriate funding agency/program for funding. Unless otherwise decided for specific projects, the Papio NRD will be the agency responsible for project administration. These projects are those which the Papio NRD would like to undertake if funding becomes available. Community-specific projects are separate (but which may have the NRD as a sponsor) and are listed in their own community sections in **Appendix E**.

In the plan, several potential mitigation projects are identified. This plan is not designed to have an all-inclusive list of projects, so the plan should be revised and updated as new projects are identified and prioritized by the Papio NRD. During the planning process, the Papio NRD Board heard the range of potential mitigation options available to them, and identified and prioritized the projects listed below. There are two groups into which the various options were prioritized: a higher-priority and lower-priority. Higher priority projects are listed in order of highest priority to lowest, as ranked by the public. Lower priority projects are not ranked in any order, but did receive votes by the public.

Recommendations

HIGHER PRIORITY PROJECTS

Include Additional Communities in Next NRD Plan Update

Prior to the commencement of this mitigation planning initiative, every community in the Papio NRD area was invited to attend one of the public meetings and to participate in the planning process. Communities that should be targeted for inclusion in the plan at the next update are: Bellevue, Gretna, Irvington, Boys Town, Decatur, Burt County, Winnebago Tribe/Winnebago, Macy, Walthill, Dakota City, and Hubbard.

Acquisition and Demolition of Floodprone Structures
The Papio NRD has an existing floodway purchase program. However, even though the NRD has acquired floodplain and floodway properties in the past, the program suffers from a lack of sustained funding. It is not unusual for the NRD to receive intermittent requests about buyouts; however, it is unable to complete the acquisitions of these properties because: 1) there is no funding available, 2) the property is located in an area which has no mitigation plan, or 3) it is not possible to develop a larger acquisition project that would be approved by the Nebraska Emergency Management Agency or Federal Emergency Management Agency. One of the benefits of a NRD-wide all-hazards mitigation plan is that all properties in the NRD boundary will be eligible for FEMA funding from its annually-funded mitigation programs.

Specific areas targeted for acquisition projects are:

- King Lake (unincorporated Douglas County) in the Elkhorn River floodway
- Elbow Bend & Iske Park (unincorporated Sarpy County) in the Missouri River floodway/floodplain
- Thompson Creek floodplain in LaVista
- All areas in the Papio NRD boundary will be considered for buyouts, as requested

Drainage Improvements
A fully-developed scenario as seen in much of the Omaha metropolitan area means that drainage and stormwater management will be an important means of reducing flood damages and flood-related nuisances. Furthermore, the flooding dynamics will continue to change as additional construction occurs around the fringes of existing development.

Potential funding sources:

1. Community Development Block Grant (CDBG) funds are available through the Nebraska Department of Economic Development for planning. Drainage studies and improvements are eligible for funding as long as the City meets low-to-moderate income requirements. Applications are always open, but there are two funding cycles each year.
2. The Papio-Missouri River Natural Resources District has funded drainage improvements in the District, some of which were identified as a part of a mitigation plan. As a stipulation for funding, the NRD will require written documentation of who or which interest will be in charge of maintaining the improvements.
3. The Flood Mitigation Assistance (FMA) program and Pre-Disaster Mitigation program through the Federal Emergency Management Agency (FEMA) receives annual allocations for projects. Fundable projects are identified in the community's approved mitigation plan, and these funds will supply up to 75% of the total project cost.

Floodplain Management
Although not commonly viewed as mitigation, effective floodplain management is the most powerful tool in preventing unwise development in floodprone areas. Most communities in the Papio NRD boundary already participate in the National Flood Insurance Program. These communities will continue to participate and will be able to turn to the Papio NRD or Nebraska Department of Natural Resources for technical assistance with specific problems and issues. The main responsibility for the administration of the local floodplain management ordinance has to do with the various aspects of reviewing and issuing floodplain development permits. If there is

no or very little floodplain area in a community's jurisdiction or if there is no or very little growth, a community's administration responsibilities in the NFIP will be extremely easy.

Also in the floodplain management category, downstream zoning of dams is idea whose time has come. There are three hazard classes of dams in Nebraska: high, significant, and low-hazard. The hazard class is determined based on the downstream land use and, as a result, have different construction standards. High hazard dams have population concentrations in the area that would be inundated if the dam were to fail. As a result, high hazard dams are constructed with ultimate safety in mind through the use of emergency spillways and extra scrutiny for dam construction plans and routine maintenance requirements. Each high hazard dam must also have an Emergency Action Plan for what to do in the event of a catastrophic failure or if the emergency spillways are used following an intense rain event. As a result of the Safety of Dams and Reservoirs Act passed by the Nebraska Unicameral in 2005, zoning of areas downstream of low and significant hazards dams is now possible. The intent is to allow development to be regulated and restricted in these areas since population moving in below a low hazard dam will cause it to be reclassified as a high hazard dam. When this happens, the dam owner would be responsible to undertake costly construction actions to raise the height of the dam, improve the dam to high-hazard specifications, and to ensure regular maintenance and inspections.

Potential funding sources:
There is no expense to communities to participate in the NFIP program other than personnel time to administer the program at the local level. Communities are also encouraged to pass zoning regulations for areas downstream of low-hazard and significant-hazard dams. The Papio NRD will also continue to provide technical assistance for floodplain management, as requested.

Flood Control
Flood control and flood damage reduction is one of the primary responsibilities of the Papio NRD. Since the NRD was created in 1972, it has constructed numerous flood retention reservoirs and has channelized long stretches of creeks in the Omaha metropolitan area. As the population of Omaha continues to increase and the area of development expands, the need for flood control dams and channelization also increases.

Flood control reservoirs deemed necessary by the Papio NRD are:
- Site 3C – Douglas County/Washington County, Big Papillion Creek
- Site 1 – Washington County, Big Papillion Creek

Channelization has been identified by the Papio NRD for:
- West Branch Papillion Creek from Papillion to Giles Road
- Big Papillion Creek from Blondo Street to Fort Street

Flood Warning
The Papio-Missouri River Natural Resources District has a real-time flood warning system for the Omaha metropolitan area – it should be explored if this warning system could be expanded to include areas outside of the metro.

Some potential flooding situations on the Platte River through the Valley area would have enough lead time for the National Weather Service to issue flood warnings. Dissemination of these flood warnings through the regular news media would provide adequate warning. In certain flood situations with less warning time, such as ice jam conditions, Papio NRD or local officials may need to directly notify affected residents.

Potential funding sources:
The U.S. Department of Commerce has grant funds for developing automated local flood warning systems, which could consist of gages installed by the USGS or from a vendor.

Outdoor Tornado Siren Assessment
Assess the outdoor tornado siren coverage for all communities within the Papio NRD boundary, using decibel and frequency of the existing sirens. Develop and implement a plan to add sirens if found to be deficient.

Potential funding sources: Unknown

Purchase NOAA Weather Radio for Critical Facilities
Weather radios are inexpensive enough that communities could purchase them for public critical facilities, such as schools and hospitals. Communities can encourage local businesses to purchase radios, especially elderly care facilities and noisy manufacturing plants which either need to be sure to receive warnings or may not be able to hear outdoor warning sirens.

Potential funding sources:
A brief online search of sites which offer NOAA Weather Radios for sale show several options with the average price being about $50-70. Depending on how many radios communities would need for critical public facilities, they might be able to purchase them. Several years ago, Region 5/6 Emergency Management out of Fremont acquired weather radios at a discounted cost and was distributing them to interested communities. County or regional emergency management agencies could perhaps perform a similar service. They are also eligible for FEMA's Hazard Mitigation Grant Program set-aside funds if they are purchased for critical facilities.

Tornado Shelter Assessment
Identify and designate tornado shelters. Any shelters that are identified should be entered into a GIS coverage for spatial analysis of shelter distribution and needs. Publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building. County and regional emergency management agencies could assist with this activity.

Potential funding sources: Unknown

Urban Tree Management Plan
For the Omaha metropolitan area, it would be beneficial to develop a comprehensive urban forest management plan, especially in areas of the city which experience
tree-related problems. Smaller communities should request a tree inventory from the Nebraska Forest Service which would give recommended actions to local tree boards. Outside of an

inventory or urban forest plan, homeowners should also know how to maintain trees on their property since they are responsible for them.

Potential funding sources:
Instead of assessing the need for financial assistance, interested communities should send a letter to the Nebraska Forest Service, requesting a community tree inventory. Tree inventories are a free service from the NFS and are beneficial in determining tree-related activities which should be taken immediately or in the near future. Even in communities which have had a tree inventory completed in the last ten years, an updated inventory would be beneficial for local tree boards or other tree-related groups to assess required actions to reduce vulnerability.

Severe Weather Awareness Education
For awareness, severe weather safety tips could be made public by newspaper or other media outlets. Such a campaign should include practical tips like staying indoors when lightning is around and could be combined with awareness campaigns from other disasters, and could take place during Severe Weather Awareness week every March.

Potential funding sources:
This is another activity which would not need to require financial resources other than staff time. Severe weather awareness campaigns can be done through various media, in cooperation with the National Weather Service, Douglas County Emergency Management Agency, Papio-Missouri River Natural Resources District, Nebraska Emergency Management Agency, Nebraska Department of Natural Resources, Federal Emergency Management Agency, U.S. Army Corps of Engineers, and other agencies at all levels.

Severe Weather Alerts
Expand public awareness about National Oceanic and Atmospheric Administration (NOAA) Weather Radio for continuous weather broadcasts and warning tone alert capability. Newer models of the weather radios are capable of supplying warnings for selected counties. The education about these radios could be done at little expense through a local newspaper article or other media outlet. County and regional emergency management agencies could offer assistance.

Identify Snow Emergency Routes
In order to most efficiently clear the streets for emergency transportation and normal vehicular traffic, snow routes should be made official and posted with signage so that local residents know to move their vehicles with the impending threat of a large snowfall. After communities determine an official snow route, maps of the snow route should be created for dissemination in publications which will be received by a majority of the community's citizens. Many communities publish snow route maps in telephone books or local newspapers. Communities should have a plan to disseminate the issuance of a snow emergency, preferably as far in advance of the culmination of the snow event as possible to allow residents to move their vehicles. Communities should have a plan to tow vehicles which are not moved upon the time a snow emergency declaration. Local officials can pass an ordinance which creates a fine for not moving vehicles which would serve as a revenue source and deterrent. The goal is to allow plow drivers to remove snow as quickly and efficiently as possible as a public safety and

transportation concern. Many communities have an unofficial snow clearing route which plow operators and residents know by heart. However, making it official and codified into local bylaws would improve efficiencies and inform all residents.

Identify Population Centers At-Risk to All Dam Failures
State statute only requires a vulnerability analysis for areas below a High Hazard dam. However, this does not mean that areas below Significant Hazard and Low Hazard dams are automatically safe from inundation in the event of failure. In order to present a true and comprehensive dam failure vulnerability assessment, an additional analysis of the potential downstream impacts for non-High Hazard dams should be performed.

LOWER PRIORITY PROJECTS

Since these projects are of a lower priority, potential funding sources are not as important to identify at this stage.

Comprehensive Levee System for Valley
A comprehensive levee system, Union Dike and No Name Dike, currently provides flood protection for almost all of the area within Valley's jurisdiction. The levee system could be improved to provide a higher level of flood protection. Providing protection against the 100-year (combined open-water and ice affected condition) would relieve residents of the requirement to purchase flood insurance and certain requirements for new development.

Potential funding sources:
Due to the large scope of the work required to raise Union Dike, the only feasible agency which could undertake such a project is the U.S. Army Corps of Engineers. This issue has been extensively explored in the last several years, and the likelihood for funding this project is relatively small. However, conditions may change in the future or a special congressional appropriation could be made specifically for this project. If this project would be funded and built, it would have a dramatic positive impact for Valley. Therefore, no matter the likelihood of funding, this project should remain in the list of potential projects.

Education and Improved Hail Warning System
Some of the most damaging natural hazards events in the Omaha metropolitan area over the last five years have been severe hail storms. There is not a lot that can be done to prevent hail damage to existing homes, but there are things that can be done to reduce future damage to new homes and to vehicles. For new homes, building options would be metal roofs instead of wood shake or traditional asphalt shingles. Another building improvement would be metal siding instead of vinyl or wood, which can be destroyed by hail strikes. Improved warning times would allow owners to move their vehicles to a protected location.

Flood Awareness Education
A flood awareness program would require the commitment of staff time from each interested community. As an example, a successful flood education public information seminar was held in Valley in 2005. Other agencies, such as the Papio-Missouri River NRD, the Nebraska

Department of Natural Resources, Federal Emergency Management Agency, and the US Army Corps of Engineers could provide assistance and educational materials. An on-going flood awareness education program might attract interested members of the public to assist as volunteers.

Potential funding sources:
Most education and outreach programs would not require funding. The only commitment would be staff time, time and money spent advertising meetings, and the cost of printing materials.

Flood Insurance Education for Homeowners
Information on how to obtain flood insurance should be provided to private property owners – it would be at their discretion to actually purchase the insurance coverage. Since the passage of the National Flood Insurance Reform Act of 1994, lenders have been required to determine if the property to be insured is in a floodplain. If it is, lenders will require flood insurance as a condition of protecting their loan. This is only for loans which are federally-backed such as mortgages or home improvements. For this potential project, "education" could mean something as easy as having FEMA flood insurance brochures available at city hall and the library up to public meetings to inform the public.

Plan Evaluation

Future plan monitoring, evaluating, and updating will follow this process:

1. Unless otherwise designated by the Papio NRD Board, the Papio NRD project staff will oversee the plan evaluation and revision process.
2. To assist with the monitoring of the plan, as a recommended project is completed, a detailed timeline of how that project was completed will be written and attached to the plan in a format selected by the Papio NRD staff. Items to be included will be: timelines, agencies involved, area(s) benefited, total funding (if complete), etc.
3. At the discretion of the Papio NRD staff, a local task force may be used to review the original draft of the mitigation plan and to recommend changes.
4. The persons overseeing the evaluation process will review the goals and objectives of the previous plan and evaluate them to see that they are still pertinent and current. Among other questions, they may want to ask themselves:
    - Do the goals and objective address current and expected conditions?
    - If any of the recommended projects have been completed, did they have the desired impact on the goal for which they were identified? If not, what was the reason it was not successful (lack of funds/resources, lack of political/popular support, underestimation of the amount of time needed, etc.)?
    - Have the nature, magnitude, and/or type of risks changed?
    - Have there been implementation problems?
    - Are current resources appropriate to implement the plan?
    - Were the outcomes as expected?
    - Are there other agencies which should be included in the revision process?
5. Any projects that have been completed since the previous plan will be noted in a "Previous Mitigation Projects" section and removed from further consideration for new projects.

6. If no further action has been made on the recommended projects of the previous version of the plan, the Papio NRD staff will document this fact.
7. Before incorporating the changes to the plan that are identified as necessary as a part of the monitoring and evaluating portions, the public will be invited to comment through the same process used in the development of the original plan: public notification through newspaper article/public notice, public meetings, and by letter of invitation to relevant stakeholders.
8. At its discretion, the Papio NRD may opt to use the plan evaluation, update, and revision worksheets given in this plan in **Appendix B.**

For future reviews, the following minimum procedures must be followed:

Task A: Evaluate the effectiveness of the planning process.

1. Reconvene the Planning Team
2. Review your Planning Process
   Items to Discuss:
   a. Building the Planning Team
   b. Engaging the Public
   c. Data Gathering and Analysis
   d. Coordinating with other Agencies

Task B: Evaluate the effectiveness of your actions.

1. What were the results of the implemented action? Did the results achieve the goals/objectives outlined in the plan? Did the actions have the intended results?
2. Were the actions cost-effective? Did (or would) the project result in the reduction of potential losses?
3. Document actions that were slow to get started or not implemented

Task C: Determine why the actions worked (or did not work)

1. Lack of available resources
2. The political or popular support for or against the action
3. The availability of funds
4. The workloads of the responsible parties
5. The actual time necessary to implement the actions

Incorporation into Existing Planning Mechanisms

There is a lack of regional planning documents into which this NRD-wide plan could be incorporated. At the discretion of the participating communities, this plan could be incorporated into the comprehensive plans of these communities. This would ensure that the mitigation component of the comprehensive plan would be consistently revisited and reviewed. However, care must taken so that this mitigation plan is reviewed and updated every five years.

Building code administration is handled at the local level and is not overseen by the Papio NRD. Upon the local adoption of the mitigation plan, each participating community will make sure that it adopts, and is enforcing, the minimum standards established in the building code used in the State of Nebraska. This is to ensure that life/safety criteria are met for new construction.

Any capital improvement planning that occurs in the future will also contribute to the goals in this hazard mitigation plan. This is another item administered at the local level and is not overseen by the Papio NRD. However, the Papio NRD may be able to work with capital improvement planners to secure high-hazard areas for low risk uses.