vehicles and/or equipment, and possibly even prevent passage entirely. Floods may be connected to outbreaks of disease from lack of fresh, clean water availability, and may also lead to an increased level of insect/pest infestation due to increased humidity and moisture levels.

Flooding Gaps and Deficiencies

- Truman has indicated that there are some residential areas within the community that are prone to flooding.

ACTIONABLE MITIGATION STEPS:

Actionable Mitigation Steps are more elaborately explained with project, timeframe, responsible jurisdictions/staff, possible funding sources, and priority level in the Action Plan section of this document. Suggested areas of focus are denoted in parentheses.

1. Focus on flood-prone areas (Truman) – Truman officials may consider addressing areas of the community that have a history of being impacted by flood events and look for methods of limiting these effects in the future.

2. Add outlet ditch or ditches and enlarge storm sewer pipes (Truman) – The City of Truman has noted that the addition of an outlet ditch or ditches and the enlargement of storm sewer pipes may assist in mitigating flood effects.

3. Careful use of wetland projects (Countywide) – Wetland replacements or restorations performed in Martin County are carefully surveyed, designed, and constructed to ensure that the retained water is not a hazard to roads and/or adjoining landowners in the vicinity. This may be the responsibility of the local city government, the private landowner, or the developer of an area, depending on the location, size, and scope of the project.

4. Have items readily available for victims and response (Granada, Truman and Fairmont) - staff (police, administration, and fire) with assistance from the county emergency management will provide educational information to be made available at all public buildings where citizens seek such information. In cases of victims and response, emergency management responders and facilities will be equipped with such material that they may assist those in need.

5. Educate key personnel in environmental hazards (Granada, Truman and Fairmont) - staff (police, administration, and fire) with assistance from the county emergency management will provide educational information to personnel and citizens with the assistance of county emergency management personnel. This information will also be provided on the city and county websites. Information will be provided in 2007 and reassessed annually. City staff and countywide emergency task force would perform this assessment.

6. Coordination with other agencies (Countywide) – In the event of a severe flood emergency, local, state, and federal agencies may have to work together effectively and efficiently to respond to an event. Local resources alone may not be adequate for responding to a severe flood event with a prolonged duration.

7. Increased communications (Countywide) – All staff, including police, administration, and fire department personnel, with assistance from county emergency management personnel will identify how to most effectively communicate with citizens in a timely manner during such an event, and will ensure that the proper equipment is in place to do so.

PART FOUR: SECONDARY NATURAL HAZARDS

The following hazards are possible, but have not been prioritized among the top three natural hazards in Martin County; they will be summarized accordingly.

WILDFIRE

A wildfire is an uncontrolled fire spreading through vegetative fuels, posing danger and destruction to property. Wildfires can occur in undeveloped areas and spread to urban areas where structures and other human development are more concentrated.

While some wildfires start by natural causes like lightning, humans cause four out of every five wildfires. Debris burns, arson or carelessness are the leading causes of wildfires. As a natural hazard, a wildfire is often the direct result of a lightning strike that may destroy personal property and public land areas, especially on state and national forest lands. The dangers from wildfire include the destruction of timber, property and wildlife, and injury or loss of life to people living in the affected area or using the area for recreational facilities.

Wildfire is a naturally occurring part of the environment. While we often think of wildfires as being "bad", it is just one way of nature eliminating dead vegetation – sort of an environmental house cleaning. However, as humans settled this country and began clearing land and building homes, roads, railroads, and campgrounds, new artificial causes of wildfire arrived on the scene.

As mentioned earlier, people burning debris cause most wildfires in Minnesota. However, wildfires are also caused by vehicle exhaust, sparks from trains and heavy equipment, camping, smoking, and lightning.

Causes of wildfires will vary from state to state. For example, in Florida, lightning ignites approximately half of all wildfires, while in Minnesota lightning causes less than 5 percent of all wildfires. These variations are due to climate, vegetation, topography, and weather.

Topography affects the movement of air and fire over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity and wind affect the severity and duration of wildfires.

Homes threatened by wildfire are primarily those located in the "wild land-urban interface". This is the zone where homes and subdivisions have been located in wild land areas where natural wildfires can have an impact. While wildfires in themselves are not bad, they burn whatever fuel is in their path, whether it is vegetation or buildings.

Wildfire can destroy or damage a home in many ways although applying simple practices can protect any home.

One of the most common causes of a home being damaged or destroyed is due to radiant heat. In a wildfire, radiant heat is the heat given off by burning vegetation. The high temperatures of some wildfires can cause the deck, siding or roof of a home to ignite, just because the fire was too near the home. Especially in areas of solid conifers (pines, spruces, junipers, and other conifers), radiant heat can be very hot. Studies have shown that when solid stands of conifers exist, a minimum of 30 feet of "defensible space" should be provided between the vegetation and the home. Studies in western wildfires have shown that approximately 85 percent of those homes

surviving a major wildfire had 30-50 feet of defensible space around the home, coupled with fire-resistant roofing.

Martin County Wildfire Hazard Risk Assessment

Hazard:	**Wildfire**
Location	Anywhere in Martin County, particularly in dry natural areas with lots of vegetation
Historic Events	None on Record
Likely to happen now?	Unlikely
How often?	Very infrequently
Where would event occur?	Natural areas with high amounts of vegetation
Severity of event?	Not likely to be severe
When would hazard likely occur?	Spring/Summer
What other hazards could occur at the same time?	Structural fire if wildfire moves into populated areas
Economic impacts	Could be significant, particularly if damage to agricultural operations occurs
Loss of life impacts	Not likely to occur
Risk Level VH – Very High H – High L – Limited M – Minimal	Citizens/People: M Animals/Livestock: M Housing: L Critical Structures: M Infrastructure: M **Total:** M
Risk Assessment	
Unlikely – 1 Occasional – 2 Likely – 3 Highly Likely – 4	**Frequency of Occurrence** 1
More than 12 hours – 1 6-12 hours – 2 3-6 hours – 3 Minimal-None – 4	**Warning Time** 1
Limited – 1 Minor – 2 Substantial – 3 Major – 4	**Potential Severity** 2
Minimal – 1 Limited – 2 High – 3 Very High – 4	**Risk Level** 1
(Total divided by 4) **Very Low – 1** **Low – 2** **Moderate – 3** **High – 4**	**Overall Priority** **1.25** **Very Low**

Vulnerability to Wildfire

Minnesota has about 2,200 wildfires every year. Wildfires occur throughout the spring, summer and fall, however, most wildfires in Minnesota take place in March, April, and May. During this period, much of the existing vegetation has been killed due to winter temperatures and most of the vegetation is dead, brown and combustible. Also, there is little green vegetation to serve as a barrier for a moving wildfire.

Although wildfires could occur anywhere throughout Martin County, there are several areas with steeper slopes and suitable vegetation pose a higher risk potential. While the probability of a wildfire occurring in these areas is greater, there still is a relatively low concern because of the sparse population and lack of infrastructure. With no documented wildfire history, the probability would be quite low for an occurrence but could escalate if climatic conditions create an ideal dry environment. Larger cities have high populations, larger housing stocks and essential utilities. However, they also have an adequate fire department, which would minimize any damages caused by wildfires before they reach the city.

Why Are We Worried about Fire?

Fire is a natural part of our environment. Our forests and prairies were burning long before our cities and towns existed.	+	People are living in the fire environment. Many homes are built and maintained without regard to wildfire.	+	With more people using our wildlands, more human-caused fire ignitions are likely	+	Today's wildfires can burn intensely and be difficult to control.	=	**Greater loss of life.** **Increased property damage.** **Damage to natural resources.** **More money spent on firefighting.**

History of Wildfire

Wildfires occur throughout Minnesota. According to the Minnesota State Fire Marshal, there are more than 2,200 annual wildfires with an estimated loss of more than $13 million dollars. There are no wildfires on record for Martin County with the National Climatic Data Center (NCDC) between the years of 1950 and 2006.

Region Nine staff has researched wildfire events in Martin County extensively during the development of this document, and has been in contact with county officials, the State of Minnesota Fire Marshall's office, and several online government databases. None of these sources were able to turn up any officially reported wildfire events. It is possible, and indeed likely, that there have been and will continue to be small wildfire events such as grass fires, but due to the relatively small impact these have events may have had to date and the efficiency with which such events are resolved by local firefighting personnel, wildfire has been deemed to be a low-priority hazard for Martin County.

Potential Impacts and Cascading Effects

The most significant impacts from wildfire are likely to be the economic impacts that can be caused by damage to natural resources or agricultural areas, as well as damages incurred to buildings or infrastructure that may be in the path of a wildfire event and consequently affected by it. Likewise, as is the case with all fires, wildfires also pose a constant threat to human life and safety, particularly for the firefighters who must work to control it.

Wildfire Gaps and Deficiencies

- Since there are state-owned lands located within Martin County, the issue of who is responsible for clearing debris (such as dry downed timber) to prevent a wildfire, or fighting a wildfire should one occur, must be clarified.

- Not all fire departments within the county may have the proper equipment, such as off-road grass rigs, to adequately fight a wildfire.

ACTIONABLE MITIGATION STEPS:

Actionable Mitigation Steps are more elaborately explained with project, timeframe, responsible jurisdictions/staff, possible funding sources, and priority level in the Action Plan section of this document. Suggested areas of focus are denoted in parentheses.

1. Proper Equipment (Countywide) – Wildfires often occur on rough terrain and in fairly remote locations, and many Martin County fire departments are not adequately equipped with the off-road capabilities (such as grass rigs) to properly deal with wildfire occurrences. Those jurisdictions that do not have their own wildfire equipment may want to make arrangements with nearby departments that do so they are prepared for a wildfire occurrence.

2. DNR Training (Countywide) – Encourage fire department participation in annual wildfire training classes that are offered by the Minnesota Department of Natural Resources Forestry Department. Participation in any other relevant training exercises is also recommended.

3. Participation in FireWise (Countywide) – The DNR participates in a national wildfire education program that is known as FireWise, which provides tools for risk assessment/reduction for interested communities. Some small grants may be available to offset the costs of participation in the program.

4. State Land Management (Countywide) – The DNR is responsible for regulating and operating all state lands within Martin County. Thinning brush and vegetation in the areas before they reach a point where they are likely to be a wildfire hazard can minimize wildfires in state-owned areas. Clarification of who is responsible for dealing with wildfires on state-owned land (i.e. local city departments or state/DNR teams) should also be addressed.

5. Fire Districts, Departments (Countywide) – Fire departments respond to any wildfires that are in their own fire district, and are also available to assist other departments or districts in the event of a large fire.

6. Zoning (Countywide) – Martin County planning/zoning staff, as well as city staff in individual communities where applicable, should review zoning ordinances to ensure that adequate distances (setbacks) are being maintained between structures and areas that may be prone to wildfire.

7. Public Education (Countywide) - County emergency management personnel will work with cities, towns and the regional development commission to develop educational material that can be presented to public via website and brochures. Brochures can be mailed to citizens in coordination with cities via utility billing or other public information mailings. This information will be provided to citizens as a means to prevent damage or impacts of wildfires.

8. Evacuation Plan (Countywide) – Cities should maintain a plan describing and depicting routes out of the community in the event of a large fire that poses an imminent threat to the community.

EXTREME TEMPERATURES

Located in the center of the continent, Minnesota and Martin County experience the extremes of summer heat and winter cold. Summer temperatures in Martin County have reached 108° F on occasions while winter temperatures have been as cold as 37° below zero. Both heat and cold pose risks for people, animals, equipment and infrastructure. Martin County has experienced five (5) reporting of extreme heat related events in the past 50 years, while four (4) occurrences of extreme cold have been reported.

Extreme Heat

In recent years a heat index has been developed that combines humidity and temperature to better reflect the risk of warm weather to animals and people. The index measures the apparent temperature in the shade. People exposed to the sun would experience an even higher apparent temperature. A heat index of 105 is considered dangerous. With prolonged exposure it could result in heat stroke, heat exhaustion and heat cramps. People are reminded to use extreme caution when the heat index is between 95 and 105. A heat index of 95 occurs when the temperature is 90 degrees and the relative humidity is 50 percent. Martin County can expect these kinds of conditions on 8 to 10 days each summer. This is more of a problem when these conditions are present for several days in a row. This allows buildings to become hotter and hotter as the conditions persist.

HEAT INDEX	Effects on the Human Body
90 to 105	**Heat stroke possible with prolonged exposure**
105 to 130	**Heat stroke likely with prolonged exposure**
130 or above	**Heat stroke highly likely with continued exposure**

Extreme Cold

Dangerously cold weather is that which produces relatively cold temperatures with strong winds, creating low wind chills that put both people and livestock at risk. Wind chills of -19 and lower can present significant risk, particularly if people are not properly clothed or protected. A 5° F air temperature with wind speeds of 30 mile per hour creates a wind chill of 19° below zero. In the open under these conditions, frostbite will occur in 15 minutes or less on exposed skin.

New Wind Chill Chart

Temperature (°F) \ Wind (mph)	Calm	5	10	15	20	25	30	35	40	45	50	55	60
40	36	34	32	30	29	28	28	27	26	26	25	25
35	31	27	25	24	23	22	21	20	19	19	18	17
30	25	21	19	17	16	15	14	13	12	12	11	10
25	19	15	13	11	9	8	7	6	5	4	4	3
20	13	9	6	4	3	1	0	-1	-2	-3	-3	-4
15	7	3	0	-2	-4	-5	-7	-8	-9	-10	-11	-11
10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17	-18	-19
5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24	-25	-26
0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31	-32	-33
-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38	-39	-40
-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45	-46	-48
-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52	-54	-55
-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60	-61	-62
-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67	-68	-69
-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74	-75	-76
-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81	-82	-84
-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88	-89	-91
-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95	-97	-98

Frostbite occurs in 15 minutes or less

Wind Chill (°F) = 35.74 + 0.6215T - 35.75($V^{0.16}$) + 0.4275T($V^{0.16}$)

Where, T = Air Temperature (°F)
V = Wind Speed (mph)

Vulnerability to Extreme Temperatures

While summers are typically warm but pleasant in Martin County, it is not uncommon to get extended warm spells with high dew points and temperatures in the 90's for several days in a row. Extended periods of warm, humid weather can create significant risks for people, particularly the elderly who may lack air conditioning or proper insulation or ventilation in their homes. Animals are also at risk during extended periods of heat and humidity.

According to the State Climatologist, there is some evidence that current dew points are not only higher but are occurring with greater frequency than was true in the past. If that is the case, Martin County residents can expect an increasing number of hours with heat indexes in the danger category.

Martin County Extreme Temperature Risk Assessment

Hazard:	**Extreme Temperature**
Location	Any location within Martin County, would likely impact vast majority of county at any given time
Historic Events	Record high of 109 degrees Fahrenheit in July of 1936, record low of –36 degrees Fahrenheit
Likely to happen now?	Yes
How often?	Extreme heat (heat index 95 degrees or above) 8-10 days per year, one day over 100 degrees every 2 years, extreme cold 2-3 days per year
Where would event occur?	Anywhere in County
Severity of event?	Depends on temperatures and duration
When would hazard likely occur?	Winter/Summer
What other hazards could occur at the same time?	Utility failure (water/wastewater plants, power outages) due to increased demand on system
Economic impacts	Crops/agricultural losses during extreme heat
Loss of life impacts	Potential due to hypothermia or heatstroke
Risk Level VH – Very High H – High L – Limited M – Minimal	Citizens/People: L Animals/Livestock: L Housing: M Critical Structures: M Infrastructure: M **Total:** M/L
Risk Assessment	
Unlikely – 1 Occasional – 2 Likely – 3 Highly Likely – 4	**Frequency of Occurrence** 2
More than 12 hours – 1 6-12 hours – 2 3-6 hours – 3 Minimal-None – 4	**Warning Time** 2
Limited – 1 Minor – 2 Substantial – 3 Major – 4	**Potential Severity** 1
Minimal – 1 Limited – 2 High – 3 Very High – 4	**Risk Level** 1
(Total divided by 4) **Very Low – 1** **Low – 2** **Moderate – 3** **High – 4**	**Overall Priority** 1.5 Very Low/Low