Hazard	Explosion	
Definition	**Fire:** rapid burning of combustible material with the evolution of heat and usually accompanied by flame *(Encyclopedia Britannica)* **Explosion:** to undergo a rapid chemical or nuclear reaction with the production of noise, heat, and violent expansion of gases <dynamite *explodes*> **b :** to burst violently as a result of pressure from within *(Webster)*	
Description	For purposes of this discussion the discussion for fires was limited to structural fires, as a result of any cause, and wild land fires. Wild land fires are intended to include grass fires, brush fires, and crop fires. These types of fires are generally not as common within incorporated areas of the community, but more common in the rural areas. According to the National Fire Protection Association (NFPA), eighty-five percent of fire deaths occur in the home (one or two-family dwellings, apartments or manufactured housing). Seventy-two percent of all fire deaths result from fires in one- and two-family dwellings, including manufactured homes. Most fires occur as a result of natural causes (i.e. lightning), accidents (i.e. gas leaks), carelessness (i.e. smoking in close proximity to combustibles), or criminal (i.e. arson) reasons. According to statistics obtained from the NFPA Iowa ranked 13th out of the 50 states in the number of deaths per million population in 1999. Cooking is the leading cause of home fires in the U.S. It is also the leading cause of home fire injuries. Cooking fires often result from unattended cooking and human error, rather than mechanical failure of stoves or ovens. Careless smoking is the leading cause of fire deaths. Smoke alarms and smolder-resistant bedding and upholstered furniture are significant fire deterrents. Arson is both the second leading cause of residential fires and residential fire deaths. In commercial properties, arson is the major cause of deaths, injuries and dollar loss. Heating is the third leading cause of residential fires. Heating fires are a larger problem in single-family homes than in apartments. Unlike apartments, the heating systems in single-family homes are often not professionally maintained.	**Rating**
Historical Occurrence	The committee did not relate any information regarding specific fire events that have occurred in the rural areas of the County, however they did acknowledge that fire departments, located in incorporated communities, have responded to numerous events in rural areas of the county. The types of fires that have occurred include both structural and wild land fires (i.e. crop fires).	3
Probability	Although much effort has been put into fire prevention in the community, based on historical occurrence, it is highly likely that numerous fires will occur in the community in the next year.	4
Vulnerability	Older structures with outdated electrical systems not built to current fire codes are particularly vulnerable to fire. Combustible building materials obviously are more vulnerable than structures constructed of steel or concrete. Structures without early detection devices are more likely to be completely destroyed before containment by response agencies. Structures in areas served by older, smaller, or otherwise inadequate water distribution infrastructure such as water mains and hydrants are also at significant risk. Problems vary from region to region, often as a result of climate, poverty, education, and demographics, but Iowa has about 13.4 fire deaths per million population.	

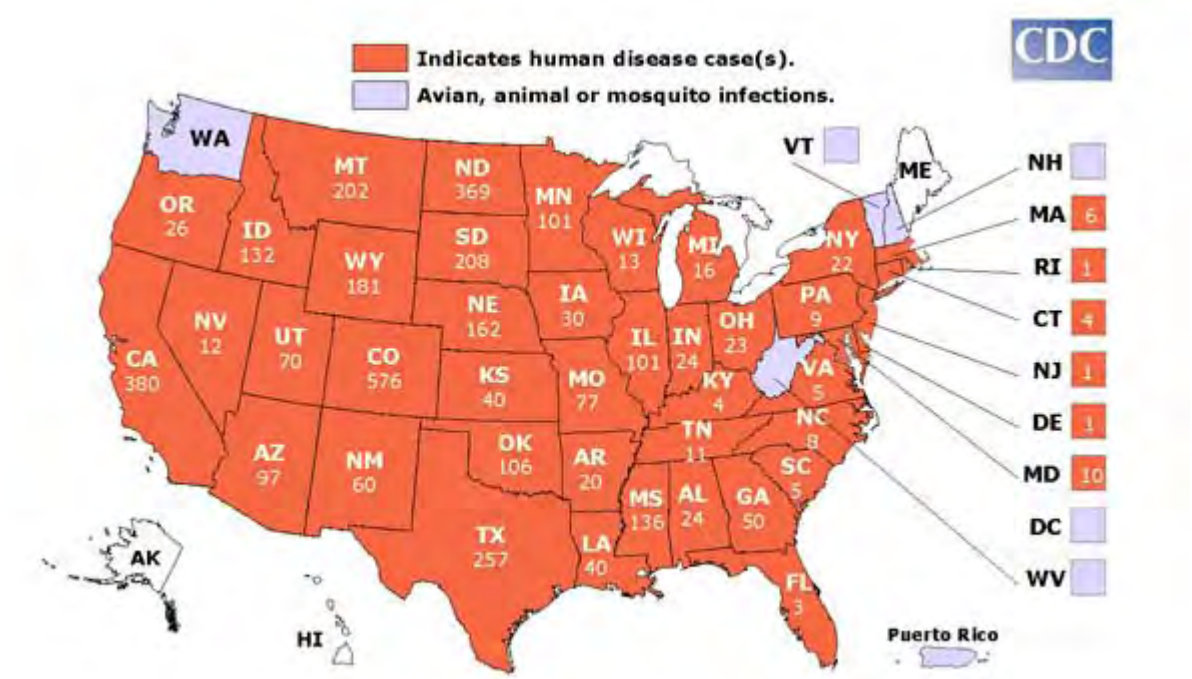
	According to the United States Fire Association, based on national statistics, senior citizens, age 65 and over, and children under the age of five have the greatest risk of fire death. The fire death risk among seniors over 65 is more than double; over age 75 triple; over age 85, three and one half times the average population. Children under the age of ten accounted for an estimated 22.2 percent of all fire deaths. Despite these statistics, based on the percentage of people likely to be directly impacted by these events, the committee felt that the risk was negligible.	3
Maximum Threat	With modern training, equipment, fire detection devices, and building regulations and inspections, most fires can be quickly contained and limited to the immediate structure involved. Certain circumstances, such as the involvement of highly combustible materials or high winds, can threaten a larger area. The age and density of a particular neighborhood can also make it more vulnerable to fire due to the spreading of fire from neighboring structures. The maximum threat of fire damage in the rural areas of Waverly increase with distance from a fire station. This is simply a reflection of the increased time it takes for area fire departments to respond to an event. The committee determined that even if a fire of unprecedented magnitudes, for this area, were to occur, it would still not impact a very large percentage of the county.	3
Severity of Impact	Based on national averages in the 1990s, there is one death for every 119 residential structure fires and one injury for every 22 residential fires. On average, each residential fire causes nearly $11,000 of damage. In nonresidential fires, there is one death for every 917 fires, one injury for each 52 fires, and each nonresidential fire causes an average of nearly $20,000 in damage. The most severe impact would likely be realized if a fire and/or an explosion occurred in a densely populated area, such as an apartment complex, factory, or dormitory. This could result in multiple deaths and property destroyed or damaged beyond repair. Furthermore, if the event occurred at a particular location it could result in the complete shutdown of an essential facility for three days or more.	5
Speed of Onset	While warning devices, such as smoke and heat detectors, can detect and warn individuals when an event is occurring, fires and explosions can and do occur with little or no warning time.	8
	Hazard Worksheet Score	**26**
	Composite Score	**26**

Hazard	**Disease**
Definition	Disease: **any impairment of normal physiological function affecting all or part of an organism, esp. a specific pathological change caused by infection, stress, etc., producing characteristic symptoms; illness or sickness in general** *(Collins)* Any medical, health, or sanitation threat to humans, plants, wildlife, domestic animals. For purposes of this discussion the topic will be contained to only communicable diseases and will deal largely with generalities.
Description	Communicable diseases can have devastating effects on a health of the population of a community, the health of wild and domestic animals, and on the wide variety of plant life that is present in and around the community. Some of these diseases are considered to be a greater risk to the community than others.

	According to the Iowa Department of Public Health website there are eleven "Emergency Reportable Diseases or Conditions" that are to be reported by telephone immediately should they be detected. These diseases include Botulism, Cholera, Diphtheria, Haemophilus influenzae type b invasive disease, Measles, Meningococcal invasive disease, Plague, Polio, Rabies (human), Vancomycin-resistant Staph aureus, and Yellow fever. Other events that should be immediately reported by telephone include outbreaks of any kind, unusual syndromes, uncommon diseases, or agents of terrorism such as anthrax, mustard gas, sarin gas, ricin, tularemia, and smallpox. Other diseases of recent concern include SARS, Hepatitis, Monkey pox, and West Nile Virus. Also, there are a variety of sexually transmitted diseases that are monitored and treated by the medical community. These diseases include Chlamydia, syphilis, gonorrhea, and HIV/AIDS. The above listed diseases are but a small sampling of diseases monitored by the Department of Public Health. Some diseases that effect livestock may include (but not limited to) West Nile Virus, Equine Infectious Anemia, Vesicular Stomatitis, Johne's Disease, Foot Rot, Coccidiosis, Pinkeye, Anaplasmosis, Anthrax, Bluetongue, Brucellosis, Trichomoniasis, Tuberculosis, Vesicular Stomatitis, Pseudorabies, Brucellosis, Porcine Reproductive Respiratory Syndrome, Brucella ovis, Ovine Progressive Pneumonia, Scrapie, Micoplasma, Newcastle, Vesicular Stomatitis, Chronic Wasting Disease (CWD), Exotic Newcastle Disease and Rabit calicivirus disease. Some common ornamental plant diseases include cedar-apple and related rusts, anthracnose, oak wilt, Verticillium wilt, ash decline, Sphaeropsis blight of pine, Rhizosphaera of spruce, Cytospora of spruce, black knot of plum, and environmental or abiotic disease, and Dutch Elm disease among others. Common plant diseases that affect Corn include Stalk Rot, Diplodia Stock Rot, common rust, Aspergillus Ear Rot, Stewart's Wilt and Flea Beetle, Holcus Leaf Spot, Corn Nematode, etc. Common soybean diseases include Bacterial Blight, Sudden Death Syndrome, etc. Other common crop diseases include Powdery Mildew, which usually affects wheat, Barley Dwarf Mosaic Virus, and Alfalfa Leaf Spot.	**Rating**
Historical Occurrence	The historical occurrence of the outbreak of communicable diseases in Waverly was difficult to determine. The planning committee could note historical occurrences of Small Pox and Influenza on relatively large scales. More recently West Nile Virus has been known to occur within the county. Historically, Pseudorabies has been a concern in hog confinement operations in the state. Influenza, mentioned before, is the most commonly recognized communicable disease and has been known to occur on a regular basis. Also known as influenza, flu is spread, or transmitted, when a person who has the flu coughs, sneezes, or speaks and sends flu virus into the air, and other people inhale the virus. The virus enters the nose, throat, or lungs of a person and begins to multiply, causing symptoms of influenza. Influenza may, less often, be spread when a person touches a surface that has flu viruses on it – a door handle, for instance – and then touches his or her nose or mouth.	3
Probability	Waverly is an agricultural crossroads for several transportation routes, including federal highways and railway. This scenario makes the probability of some type of human disease, plant disease, animal disease, or some combination of the three very likely in the near future. The probability is compounded when considering that the severity of many viruses is increasing as they develop more resistance to the antibiotics and medications that are currently available. While many safeguards are in place to mollify the occurrence of these disease epidemics before they occur, the probability still remains highly likely that an event will occur within the next year.	4

Vulnerability	While the entire population of human, animal, and plant life is vulnerable to some degree, implementing certain precautionary measures can reduce the amount of vulnerability. Some precautions for humans include education on how diseases are contracted and/or spread, cleanliness, safe food handling practices, vaccinations, implementing monitoring programs, and practicing safe sex measures. The risk of disease in animals can be largely reduced by ensuring domesticated animals receive the proper nutrition in their diet, living areas are kept as dry as possible, sick animals are quickly identified and treated, proper vaccinations are administered, and dead animals are quickly and properly disposed.	4
Maximum Threat	The maximum extent of disease epidemic (human, animal, and plan) could potentially reach far beyond the borders of the County. In fact, because the community has a number of major transportation routes that run in or near the likelihood of a disease being quickly spread to other areas of the State, Nation, and even the world are greatly enhanced.	5
Severity of Impact	A number of the diseases that have been identified as potential risks to the community can result in death. Up to the point of death, the diseases that could take place in the community there are a variety of symptoms that can sometimes be treated with proper medications. As mentioned before, there are numerous safeguards that have been put into place to help deter and event before it begins, respond to an event once it does occur, and recover from an event as quickly as possible. Examples of such precautions include measures by service agencies (i.e. American Red Cross), government agencies (i.e. Bremer County EMA, Bremer County Health Department, State Veterinarian, USDA, etc.), and private medical facilities (i.e. hospitals and clinics) to detect and respond to an event before it becomes an epidemic. The County faces an increased potential for economic loss should a plant or animal disease epidemic impact the agricultural industry. This is the case because a large percentage of the local economy is based on agribusiness (i.e. John Deere, IBP, farms, etc.).	5
Speed of Onset	The committee felt that the speed of onset for an actual disease epidemic would more than likely be in excess of 24 hours. There was recognition that in some rare instances that may not be the case. Due to a well developed public health system with reporting and tracking measures in place, and the fact that most diseases take at least one day to fully incubate that the speed of onset would not be as fast as with some of the other identified disasters.	2
	Hazard Worksheet Score	**23**
	Composite Score	**35**

Figure 17: West Nile Virus in the United States as of April 1st, 2008



Hazard	Riot/Violent Demonstration	
Definition	A tumultuous disturbance of the public peace by three or more persons assembled together and acting with a common intent. (Merriam-Webster Dictionary)	
Description	Riot/Violent Demonstration is generally a form of civil disorder characterized by organized or disorganized groups lashing out in rash of violence, vandalism or other crime. These hazards often occur in reaction to a perceived grievance or out of dissent. Riots/Violent Demonstrations typically involve vandalism and the destruction of private and public property. The specific property to be targeted varies depending on the cause of the riot and the inclinations of those involved. Targets can include shops, cars, restaurants, state-owned institutions, and religious buildings.	**Rating**
Historical Occurrence	The committee reported several incidents of riot/violent demonstrations in recent history. Primarily these events have occurred in relation to labor disputes, anti-abortion protests, sheriff and agricultural sales, and foreclosures. Rural foreclosures are rank number one out of all foreclosures in the State of Iowa. These events have consistently been dealt with in a timely and effective manner by law enforcement. Larger events have relied heavily on mutual aid agreements with other counties. Waverly will continue to maintain these agreements for events such as these.	1
Probability	The likelihood these events will happen in Waverly are moderate for the future. Based off past historical occurrence the committee felt a riot/violent demonstration may occur once every five to ten years.	2
Vulnerability	Vulnerability to a riot or violent demonstration occurring and escalating in the county is unlikely. Waverly has excellent channels of communication. Government and private entities work very close with one another and do not hesitate to contact proper authorities when assistance is needed.	2

Maximum Threat	In the event of a riot/violent demonstration the committee felt county law enforcement would be able to diffuse the situation before any significant damage or injury occurred. If the county did not have the capacity to deal with the situation solely, mutual aid agreements with other jurisdictions would be utilized. Maximum threat to the county is minimal.	2
Severity of Impact	The severity of impact would largely depend on how quickly law enforcement became aware of the event and diffused the crowd before hostility peaked. The worst-case scenario would occur if law enforcement had no knowledge until the rioting/violently demonstrating group began acting on their emotions.	3
Speed of Onset	Depending on the groups level of motivation would determine how quick they began acting out in violence. For example, in the event of a foreclosure homeowners would likely act out more quickly due to desperation where anti-farming activists may desire to simply have their opinions heard by certain persons.	7
	Hazard Worksheet Score	**17**
	Composite Score	**37**

Hazard	**Sink Holes**	
Definition	A natural depression in a land surface communicating with a subterranean passage, generally occurring in limestone regions and formed by solution or by collapse of a cavern roof. (Merriam-Webster Dictionary)	
Description	Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by ground water circulating through them. As the rock dissolves, spaces and caverns develop underground. Sinkholes are dramatic because the land usually stays intact for a while until the underground spaces just get too big. If there is not enough support for the land above the spaces then a sudden collapse of the land surface can occur.	
	New sinkholes have been correlated to land-use practices, especially from ground-water pumping and from construction and development practices. Sinkholes can also form when natural water-drainage patterns are changed and new water-diversion systems are developed. Some sinkholes form when the land surface is changed, such as when industrial and runoff-storage ponds are created. The substantial weight of the new material can trigger an underground collapse of supporting material, thus causing a sinkhole. The overburden sediments that cover buried cavities in the aquifer systems are delicately balanced by ground-water fluid pressure. The water below ground is actually helping to keep the surface soil in place. Ground-water pumping for urban water supply and for irrigation can produce new sinkholes In sinkhole-prone areas. If pumping results in a lowering of ground-water levels, then underground structural failure, and thus, sinkholes, can occur. (USGS)	**Rating**
Historical Occurrence	Waverly does not have a history of sink holes although it is assumed there are sink holes that have not yet been located.	2
Probability	With many different soil types, a high prevalence of precipitation and current agricultural practices which focus on re-directing natural water flow the probability of sink holes developing is likely.	3

Vulnerability	The public's vulnerability to property damage, injury and loss of life as a result of a sink hole is dismal. The onset of sink holes is very slow. Failure to identify a sink hole could increase the public's vulnerability. Building near and or around these areas is highly discouraged.	2
Maximum Threat	The maximum threat to the public occurs when a sink hole has not yet been identified. Property owners continuing current practices which may have created the sink hole will only further subject that property owner and future property owners to property damage.	2
Severity of Impact	Unknown sink holes with property located near and around the structure could have a significant impact on the structures in the area if the sink hole were to collapse. Personal property located near the sink hole would also be consumed in the event of a collapse.	2
Speed of Onset	Sink holes growing in mass is a slow yet gradual process. Land use practices in the area, soil type in addition to a number of other factors will impact the speed of onset. By identifying these areas city agencies and property owners will be able to implement the necessary precautions to slow and potentially eliminate the development of a sink hole.	5
	Hazard Worksheet Score	**16**
	Composite Score	**16**

Hazard	**Radiological Event**	
Definition	An incident resulting in a release of radiological material at a fixed facility to include power plants, hospitals, laboratories and the like.	
Description	Although the term "nuclear accident" has no strict technical definition, it generally refers to events involving the release of significant levels of radiation. Most commercial nuclear facilities in the United States were developed in the mid-1960s and are designed to withstand aircraft attack. Therefore, they should withstand most natural hazards even though they may not have been specifically designed for those forces. Other types of radiological incidents can occur as a result of purpose, as in the case of terrorism; by missile or bomb, as in the case of aggression by a foreign state; or by transportation, during the transportation of radiological waste.	**Rating**
Historical Occurrence	Emergency classifications are divided into four categories. Each calls for a certain level of response from plant and government personnel. From least to most severe, the classifications are: Unusual Event, Alert, Site Area Emergency, and General Emergency. Since 1990, the Duane Arnold Energy Center, which is located in the closest proximity to the community, has had 5 Unusual Events, no Alerts, and no Site Area Emergencies or General Emergencies.	1
Probability	Operators of facilities that use radioactive materials and transporters of radioactive waste are circumspect in the packaging, handling, and shipment of the radioactive waste; and, since they are closely regulated by a variety of federal, state, and local organizations, the likelihood of an incident is remote.	1
Vulnerability	Radiation exposure from the sun, radioactive elements in the soil and rocks, household appliances, and medical and dental x-rays account for most of the exposure sources; 71% of radiation exposure sources in the U.S. come from natural background radiation. Radon from rocks and soil contribute 55% of all sources of radiation in the U.S. Cracked, poorly ventilated basements can contain high levels of radon, and hence increase exposure to those in the house who spend significant time in the contaminated basement. Other sources of radioactive materials include medical products, industrial products, nuclear power plant fuel, nuclear weapons, and radioactive waste from hospitals, laboratories, nuclear reactors, and military facilities.	

	Although the committee determined that the probability of an event was limited, they recognized that if an event were to occur in, or in close proximity, to the community that the entire population would be vulnerable to the radiation.	4
Maximum Threat	Wide-scale radiological hazards would come from naturally occurring radiation such as radon. According to the United States Geological Survey, all of Iowa has a high potential of exposure to geologic radon. As mentioned previously, the committee recognized that if an event were to occur that the entire population would have some risk of exposure to radiation, which could result in death.	5
Severity of Impact	Time, distance, and shielding minimize radiation exposure to the body. Nuclear radiation above normal levels would be a health and safety consideration because of its ability to damage human cells biologically as well as its long-lasting effect on the environment. Depending on the level of exposure, radiation can cause loss of life, long- and short-term health effects, property damage from contamination, and disruption of business because of potential evacuations. Therefore, multiple deaths could occur, thereby affecting the operation of essential facilities throughout the community, at least temporarily.	5
Speed of Onset	Ionizing radiation cannot be seen, smelled, heard, or detected with human senses. Detection instruments are needed to indicate the existence of dangerous radiation. Distance from the incident would dictate the amount of time needed to avoid exposure from damaging radiation. Protective actions directed by state and local officials, will depend upon weather conditions and developments at the power plant. In an actual emergency, the public can turn to their local Emergency Alert System Station or NOAA Weather Radio.	6
	Hazard Worksheet Score	**22**
	Composite Score	**34**

Figure 18: Picture of Duane Arnold Energy Center Near Palo, Iowa

Hazard	Land Slides/ Mud Flows	
Definition	The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there are other contributing factors: erosion by rivers, glaciers, or ocean waves create oversteepened slopes rock and soil slopes are weakened through saturation by snowmelt or heavy rains earthquakes create stresses that make weak slopes fail earthquakes of magnitude 4.0 and greater have been known to trigger landslides volcanic eruptions produce loose ash deposits, heavy rain, and debris flows excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures Slope material that become saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, thus blocking bridges and tributaries causing flooding along its path. (USGS)	
Description	Landslides constitute a major geologic hazard because they are widespread, occur in all 50 states and U.S. territories, and cause $1-2 billion in damages and more than 25 fatalities on average each year. Expansion of urban and recreational developments into hillside areas leads to more people that are threatened by landslides each year. Landslides commonly occur in connection with other major natural disasters such as earthquakes, volcanoes, wildfires, and floods. (USGS)	Rating
Historical Occurrence	The committee did not comment on any documented landslides/ mud flows in the city although they were certain these events have happened. They felt these events were likely to occur in steep sloping areas near and around the branches of the Cedar River.	1
Probability	These events are highly probable near the steep sloping areas of the city which are predominately located near rivers. Probability is increased significantly in areas with sloping land cleared of timber and shrubbery.	1
Vulnerability	Vulnerable populations include those located at the top and/or bottom of steep sloping areas. There is no stopping ground from giving way once it reaches a specific level of saturation.	1
Maximum Threat	Maximum threat exists to those property owners located at the top or bottom of steep sloping areas without trees or shrubbery to absorb excessive amount of moisture.	1
Severity of Impact	For structures located at the top or bottom of a landslide the severity of impact could be devastating. Earth giving way from underneath a structure could result in the structure giving way also. All ground that does give way will then topple onto the anything located below.	1
Speed of Onset	Great amounts of precipitation and moisture over time will greatly increase the speed of onset.	6
	Hazard Worksheet Score	**11**
	Composite Score	**11**

Hazard	Grass/ Wild Lind Fires
Definition	Combustion, marked by flames or intense heat, in natural settings, often ignited by lightning or human activities. For fires set as part of natural resource management, use controlled fires. (USGS)

Description	Wildfires are a growing natural hazard in most regions of the United States, posing a threat to life and property, particularly where native ecosystems meet developed areas. However, because fire is a natural (and often beneficial) process, fire suppression can lead to more severe fires due to the buildup of vegetation, which creates more fuel. In addition, the secondary effects of wildfires, including erosion, landslides, introduction of invasive species, and changes in water quality, are often more disastrous than the fire itself.	**Rating**
Historical Occurrence	Grass/wild land fires have historically occurred in late fall and early spring when citizens have engaged in ditch burning. Cornfield fires have been more prevalent in the fall when corn saturation and precipitation is low.	5
Probability	The probability of a grass/wild land fire is moderate to likely. The vast amount of ditch burning that occurs, the abundance of cornfields, and lack of precipitation in spring and fall increases chances greatly.	6
Vulnerability	The committee did not relate any information regarding specific fire events that have occurred in the rural areas of the County, however they did acknowledge that fire departments, located in incorporated communities, have responded to numerous events in rural areas of the county. The types of fires that have occurred include both structural and wild land fires (i.e. crop fires).	3
Maximum Threat	With modern training, equipment, fire detection devices, and building regulations and inspections, most fires can be quickly contained and limited to the immediate structure involved. Certain circumstances, such as the involvement of highly combustible materials or high winds, can threaten a larger area. The age and density of a particular neighborhood can also make it more vulnerable to fire due to the spreading of fire from neighboring structures. The maximum threat of fire damage in the rural areas of the city increase with distance from a fire station. This is simply a reflection of the increased time it takes for area fire departments to respond to an event. The committee determined that even if a fire of unprecedented magnitudes, for this area, were to occur, it would still not impact a very large percentage of the county.	3
Severity of Impact	The most severe impact would likely be realized if a grass/ wild land fire in a densely populated area, such as an apartment complex, factory, or dormitory. This could result in multiple deaths and property destroyed or damaged beyond repair. Furthermore, if the event occurred at a particular location it could result in the complete shutdown of an essential facility for three days or more.	4
Speed of Onset	While warning devices, such as visual detection and warn individuals when an event is occurring, grass/wild land fires can and do occur with little or no warning time.	7
	Hazard Worksheet Score	**28**
	Composite Score	**56**

Hazard	**Levee Failure**
Definition	A levee embankment, flood bank or stop bank is a natural or artificial slope or wall to prevent flooding of the land behind it. It is usually earthen and often parallel to the course of a river or the coast. A levee failure is when part of the levee actually breaks away, leaving a large opening for water to flood the land protected by the levee.

Description	Man-made levees can fail in a number of ways. The most frequent (and dangerous) form of levee failure is a breach. A breach can be a sudden or gradual failure that is caused either by surface erosion or by a subsurface failure of the levee. Levees are also said to fail when water *overtops* the crest of the levee. *Levee overtopping* can be caused when flood waters simply exceed the lowest crest of the levee system or if high winds begin to generate significant swells in the ocean or river water to bring waves crashing over the levee. Overtopping can lead to significant landside erosion of the levee or even be the mechanism for complete breach. Properly built levees are armored or reinforced with rocks or concrete to prevent erosion and failure.	**Rating**
Historical Occurrence	Levee failure near Waverly has primarily been overtopping. Minimal property and crop damage has resulted from these events. No levee failures resulted in the 2008 record flooding events.	1
Probability	The likelihood of a levee breaching or overtopping in the county is a possibility. The pure existence levees create this potential. Chances increase significantly with long snow and ice filled winters followed by rainy springs. Earthen levees reaching a certain point of saturation during a flooding event will eventually result in a breach or overtopping.	1
Vulnerability	No area in Waverly currently depends on levee protection. The public's vulnerability to property damage, injury and loss of life is dismal. If a levee were to fail in a flooding event the county would be able to recovery fairly easy.	1
Maximum Threat	By maintaining and periodically inspecting all existing levees the potential for severe damage is reduced significantly. Properties and structures located behind levees would be most impacted in the event of a levee failure. Threat to surrounding properties and communities is minimal.	1
Severity of Impact	Any structures behind the levee are susceptible to property damage if the levee were to fail. The water behind the levee is very forceful. When the levee breaks the water will rush into the protected area very fast and with the potential to destroy anything in its path. Structures protected by the levee are generally not built to withstand flood waters.	4
Speed of Onset	The speed in which a levee becomes breaches or overtops can be gauged with rising water and the duration the water remains at excessive level. When the levee actually breaches the negative repercussions of flood water spilling into undesignated areas a will be instantaneous. Being able to accurately predict a breaching event is very difficult to near impossible. It should be assumed all levees will fail in the event of a severe flood.	6
	Hazard Worksheet Score	**14**
	Composite Score	**49**

Hazard	**Expansive Soils**	
Definition	Types of soil that shrink or swell as the moisture content decreases or increases. (USGS)	
Description	The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall. The hazard occurs in many parts of the Southern, Central, and Western United States. Recent estimates put the annual damage from expansive soils as high as $7 billion. However, because the hazard develops gradually and seldom presents a threat to life, expansive soils have received limited attention, despite their costly effects.	**Rating**
Historical Occurrence	Similar to every other community in Iowa, Waverly roadways are affected by expansive soils. This hazard is most evident by potholes that cause damage to Iowa roadways and vehicles. The Engineering Department is responsible for filling in and/or repairing potholes when they occur.	

	Probability and frequency analyses have not been prepared because of the nature of occurrence of this hazard. This is consistent with other geologic hazards that occur slowly over time.	6
Probability	Probability and frequency analyses have not been prepared because of the nature of occurrence of this hazard. This is consistent with other geologic hazards that occur slowly over time.	6
Vulnerability	Expansive soils have little if any direct human impacts. Impacts commonly involve swelling clays beneath areas covered by buildings and slabs of concrete and asphalt, such as those used in construction of highways, walkways, and airport runways.	6
Maximum Threat	The availability of data on expansive soils varies greatly. In or near metropolitan areas and at dam sites, abundant information on the amount of clay generally is available. However, for large areas of the U.S., little information is reported other than field observations of the physical characteristics of clay.	5
Severity of Impact	The most extensive damage from expansive soils occurs to highways and streets. Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling than are multi-story buildings, which usually are heavy enough to counter swelling pressures. The most obvious manifestations of damage to buildings are sticking doors, uneven floors, and cracked foundations, floors, walls, ceilings, and windows.	4
Speed of Onset	This is consistent with other geologic hazards that occur slowly over time.	4
	Hazard Worksheet Score	**31**
	Composite Score	**31**

RISK ASSESSMENT

The risk assessment identifies how people, properties, and structures will be damaged by the event. If the hazard can harm people or damage their homes and other structures, they are vulnerable. Finding the weak points in the system, for example, identifying building types that are vulnerable to damage and anticipating the loss in high risk areas, will help the community decide what mitigation measure should be undertaken and how to implement the activities they select.

In making their hazard analysis and risk assessment, the Waverly Planning Committee considered the following

Historical Occurrence
Probability
Vulnerability
Maximum Threat
Severity of Impact
Speed of Onset

The following tables define each factor and the rating scale the Planning Committee used to assess the hazards risk to the community.

Historical Occurrence – Number of times that a hazard has occurred in the community in the past

Rating	Number of Historical Occurrences
1-3	Less than 4 occurrences
3-5	4 to 7 occurrences
5-7	8 to 12 occurrences
7-9	More than 12 occurrences

Probability – Likelihood of the hazard occurrence, sometimes without regard to hazard history.

Rating	Likelihood	Frequency of occurrence
1-3	Unlikely	Less than 1% probability in the next 100 years
3-5	Possible	Between 1 and 10% probability in next year, or at least one chance in the next 100 years
5-7	Likely	Between 10 and 100% probability in next year, or at least one chance in next 10 years
7-9	Highly Likely	Near 100% chance in the next year

Vulnerability – Measure of the percentage of people and property that would be affected by the hazard event

Rating	Magnitude	Percentage of people and property affected
1-3	Negligible	Less than 10%
3-5	Limited	10 to 25%
5-7	Critical	25 to 50%
7-9	Catastrophic	More than 50%

Maximum Threat – Spatial extent of the community that might be impacted

Rating	Magnitude	Percentage of jurisdiction that can be affected
1-3	Negligible	Less than 10%
3-5	Limited	10 to 25%
5-7	Critical	25 to 50%
7-9	Catastrophic	More than 50%

Severity of Impact – Assessment of the severity in terms of fatalities, injuries, property losses, and economic losses

Rating	Level	Characteristics
1-3	Negligible	Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.
3-5	Limited	Minor injuries and illness. Minor or short term property damage which does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.
5-7	Critical	Serious injury and illness. Major or long term property damage, which threatens structural stability.

		Shutdown of essential facilities and services for 24 to 72 hours.
7-9	Catastrophic	Multiple deaths. Property destroyed or damaged beyond repair. Complete shutdown of essential facilities and services for 3 days or more.

Speed of Onset – Potential amount of warning time available before the hazard occurs

Rating	**Probable amount of warning time**
1-3	More than 24 hours warning time.
3-5	12 to 24 hours warning time.
5-7	5 to 12 hours warning time
7-9	Minimal or no warning time.

HAZARD ANALYSIS SUMMARY

The Waverly Hazard Mitigation Planning Committee formed a subcommittee that reviewed and scored all of the hazards considered to be relevant for their community. The list was then presented to the full planning committee for their review. The hazards are listed below in order of their score.

Winter Storm
Thunderstorm
Tornado/High Wind Event
Flood (Riverine & Flash)
Transportation
Communication Failure
Watershed Pollution
Fire
Expansive Soils
HAZMAT
Dam Failure
Grass/Wild land Fires
Heat Wave/Extreme Heat
Explosion
Terrorism
Earthquake
Drought
Disease
Radiological Event
Riot/Violent Demonstration
Sink holes
Levee Failure
Bridge Failure
Land Slides/Mud Flows

The following is a breakdown of the score for each hazard that was identified and scored by the subcommittee. The table is organized in the order descending order, with the hazard that accumulated the highest total score listed first.

	Historical	Probability	Vulnerability	Maximum Threat	Severity	Speed of Onset	Total
Winter storm	9	9	7	8	5	5	43
Thunderstorm	9	9	7	6	4	5	40
Tornado/High Wind Event	5	5	7	7	8	8	40
Flood (Riverine & Flash)	7	7	7	7	7	4	39
Transportation	8	8	3	3	4	8	34
Communication Failure	4	5	5	6	6	8	34
Ground Water Contamination	5	6	6	6	5	6	34
Fire	7	7	3	3	5	8	33
Expansive Soils	6	6	6	5	4	4	31
HAZMAT	3	5	4	4	5	8	29
Dam Failure	1	2	6	6	6	8	29
Grass/ Wild land Fires	5	6	3	3	4	7	28
Heat Wave/ Extreme Heat	5	5	5	5	5	2	27
Explosion	3	4	3	3	5	8	26
Terrorism	1	3	4	5	5	8	26
Earthquake	1	2	4	4	5	8	24
Drought	4	4	5	6	4	1	24
Disease	3	4	4	5	5	2	23
Radiological Event	1	1	4	5	5	6	22
Riot/ Violent Demonstration	1	2	2	2	3	7	17
Sink Holes	2	3	2	2	2	5	16
Levee Failure	1	1	1	1	4	6	14
Bridge Failure	1	1	1	3	2	3	11
Land Slides/ Mud Flows	1	1	1	1	1	6	11
				Average total score:	28		

COMPOSITE SCORING

The Iowa Emergency Management Department has provided communities with a Cascading Event Matrix. This matrix analyzes each hazard and how each hazard has the potential to cause and affect other hazards. Based on the matrix scores and the scoring process for the risk assessment, each Waverly hazard was given a composite score. These are listed below.

Hazard	Hazard Worksheet Score[1]	Number Caused[2]	Number Resulting From[2]	Composite Score
Natural Hazards				
Thunderstorm (hail, lightning, heavy rain)	*40*	*0*	*19*	*59*
Flood (Riverine & Flash)	*39*	*4*	*16*	*55*
Winter Storm (snow, ice, extreme cold)	*43*	*0*	*10*	*53*
Tornado / High Wind Events	*40*	*1*	*14*	*54*
Excessive Heat	*27*	*0*	*6*	*33*
Drought	*24*	*1*	*5*	*29*
Earthquake	*24*	*0*	*14*	*38*
Sinkholes	*16*	*N/A*	*N/A*	*16*
Human-Caused Accidental Hazards				
Communications Failure	*34*	*16*	*9*	*59*
Transportation (planes, trains, automobiles)	*34*	*9*	*4*	*47*
Nuclear (Fixed Radiological Incident)	*22*	*7*	*5*	*34*
HAZMAT (including meth labs)	*29*	*14*	*2*	*45*
Dam Failure	*29*	*9*	*11*	*49*
Bridge Failure	*11*	*N/A*	*N/A*	*11*
Human-Caused Purposeful Hazards				
Terrorism (Conventional)	*26*	*0*	*17*	*43*
Civil Disturbances	*17*	*17*	*3*	*37*
Other/Combination Hazards				
Fire (Structural)	*33*	*17*	*6*	*56*
Groundwater Contamination	*34*	*N/A*	*N/A*	*34*
Power Failure	*35*	*N/A*	*N/A*	*35*
Explosions (gas, elevators, other)	*26*	*N/A*	*N/A*	*26*
Disease (Human or Animal Epidemic)	*23*	*10*	*2*	*35*

The cascading matrix score is important as is shows how one hazard can quickly lead to a larger, more disastrous event. When examining the above table, Thunderstorm/Hail/ Lightning and Communications Failure events received the highest composite scores. This occurrence is due to the fact that so many other events can result from these types of incidents. These are examples of how cascading events can result in exponential consequences.

INVENTORY OF ASSETS

ASSET INVENTORY

In order to identify the most appropriate mitigation techniques and projects, the city determined to identify the assets in the community. The following table lists community assets that would be affected in the event of a large hazard that could affect the entire community. These hazards include: Tornado/High Wind Event, Winter Storm, Thunderstorm/Lightning/Hail, Drought, Excessive Heat, Flood, and Earthquakes. In these events, the entire Community is the "Hazard Area"

Type of Structure	Number of Structures			Value of Structures			Number of People		
	# in City	# in Hazard Area	% in Hazard Area	$ in City	$ in Hazard Area	% in Hazard Area	# in City	# in Hazard Area	% in Hazard Area
Residential	2,661	2,661	100%	302,729,616	302,729,616	100%	8,968	8,968	100%
Commercial	673	673	100%	75,571,370	75,571,370	100%			
Industrial	68	68	100%	25,466,120	25,466,120	100%	N/A	N/A	N/A
Agriculture	0	0	100%	216,630	216,630	100%	N/A	N/A	N/A
Religious/ Non-Profit	16	16	100%	4,817,610	4,817,610	100%	N/A	N/A	N/A
Government	9	9	100%	3,573,396	3,573,396	100%	N/A	N/A	N/A
Education	6	6	100%	13,449,960	11,208,300	100%	1,986	1,986	100%
Utilities	15	15	100%	2,873,140	2,873,140	100%	N/A	N/A	N/A

Residential/Commercial/Industrial/Agricultural Value = Assessed value
Religious = Churches and one Parochial School
Government = City Hall, fire station, public works building, library, hospital
Education = Staff and students at public school grades K - 12
Utilities = Wastewater treatment plant, water plant and city wells

HAZARDS WITH DEFINED RISK AREAS

Hazardous Materials (Including Methamphetamine Labs)

The defined risk area for hazard materials hazards and methamphetamine lab hazards includes structures and people within ¼ mile (3-4 blocks) of facilities. Refer to *Attachment 6: Critical Sites Map of the City* and Figure 10 in this plan for known locations of hazardous materials in Waverly.

Riverine Flooding

In the City of Waverly there are approximately 936 persons who reside year-round in the 100-year floodplain. Currently there are 400 houses and 134 commercial and industrial structures located within the city's 100-year floodplain. Refer to the attached *Attachment 2: Floodplain Map of the City* for a view of the current floodplain map, which defines the estimated flood hazard areas in the City of Waverly.

An attempt was made to estimate the losses that would occur in the event of a 100-year or a 500-year flood. The attached map, *Attachment 5: Flood Scenario Map of the City,* shows the areas of the city that would be impacted in the event of a 100-year or 500-year flood. In addition, the attached map, *Attachment 6: Critical Sites Map of the City* shows the critical facilities that would be impacted in such an event. Estimated impacts of a 100-year flood are as follows:

100-Year Flood Event

Type of Structure	Number Impacted	Estimated Loss*
Residential	400	$45,506,000
Commercial	122	$12,699,380
Industrial	12	$4,494,012
Agriculture	NA	NA
Religious/Non-Profit	6	$1,806,604
Government	2	$794,532
Education	3	$5,604,150
Utilities	4	$766,172
Total	549	$71,670,850

*Assuming a total loss

As can be seen, in the event of a 100-year flood approximately 534 private structures would be impacted. Of these structures 400 are housing units and 134 are commercial or industrial properties. In addition, three schools, four lift stations, the City Hall, and the Fire Department are located in the 100-year floodplain. Using the asset inventory information above estimates can be made as to the cost of such a flood event

Flash Flooding

Areas at risk for flash flooding include low-lying areas, scattered throughout community, specifically the areas of the city in the 100-year floodplain noted above.

Tornado

While everyone and every structure is vulnerable to the impacts of a tornado, it is unlikely that one tornado would directly impact the entire community. The attached *Attachment 4: Tornado Scenario Map of the Community* is a map of a mock tornado event. The event is based on the average sized tornado occurrence in Iowa. The event is shown impacting highly populated and developed areas of the larger metropolitan area. This tornado scenario estimates that 1, 399 structures would fall in the path of the tornado. Assuming a total loss, the estimated damage costs are below.

Estimated Tornado Scenario

Type of Structure	Number Impacted	Estimated Loss*
Residential	1,067	$121,387,255
Commercial	277	$31,104,330
Industrial	27	$10,111,527
Agriculture	NA	NA
Religious/Non-Profit	10	$3,011,006
Government	3	$1,588,176
Education	4	$8,966,640
Utilities	11	$2,106,969
Total	1,399	$178,275,903

*Assuming a total loss

VULNERABILITY ASSESSMENT

Winter Storm Vulnerability

As with thunderstorms, hail, and lightning, the entire community would be vulnerable to a winter storm.

Again, within the city there exist groups that may be even more vulnerable to winter storm events, specifically the elderly and disabled. These persons may not be able to reach safety in the event of a hazard event or a multi-hazard event that can result from a winter storm. At the time of the 2000 Census, there were a total of 2,208 persons over the age of 64 and/or disabled.

Finally, based on the large area that these storms can cover and the cascading effects that can accompany them, the entire population and area is vulnerable to some type of impact from a winter storm. The committee recognized this as fact and scored it accordingly.

Thunderstorm/Lightning/Hail Event

It is possible that in the event of a thunderstorm/lightning/hail event, the entire community could be vulnerable. In that event, a total of 3,447 structures would be affected, a total of 8,968 persons would be affected and buildings worth a total of $428,697,842 could be damaged.

Because of the elements involved with a thunderstorm (tornados, hail, high wind, lighting, heavy rain) many persons may be vulnerable to the damaged caused by these storms. Those individuals most at risk would include those people outdoors, in mobile homes, in low lying areas susceptible to flash flooding, etc.

At the time of the 2000 Census, there were 84 mobile homes/manufactured housing units in Waverly. Again using the average persons per household, there are approximately 198 persons living in manufactured housing units in Waverly.

Populations living in the low-lying 100-year floodplain are also at risk during thunderstorm/ lightning/hail events. According to the City, approximately 400 housing units currently remain in the 100-year floodplain. All of these structures are susceptible to flooding in the future. All of the residents of the houses are also vulnerable to damage from floodwaters. Again, assuming