HAZARD IDENTIFICATION AND VULNERABILITY ANALYSIS (HIVA)

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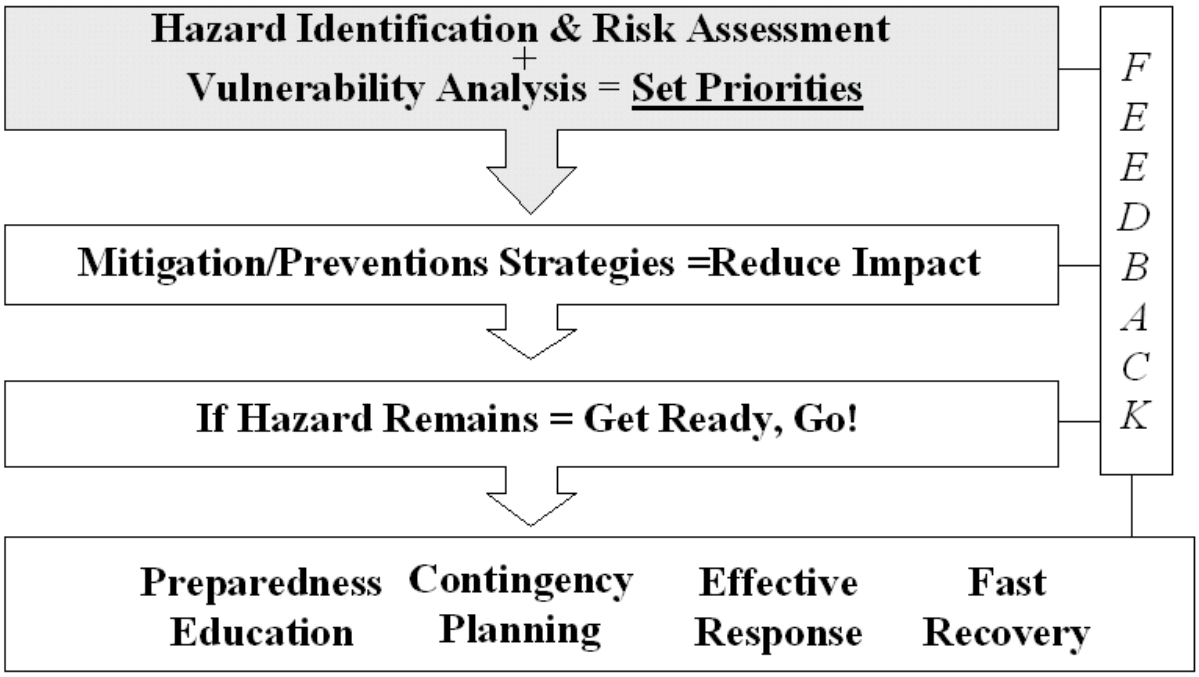
HAZARD IDENTIFICATION AND VULNERABILITY ANALYSIS (HIVA) TABLE OF CONTENTS

An Integrated Emergency Management Approach



HAZARD IDENTIFICATION AND VULNERABILITY ANALYSIS (HIVA)

I. INTRODUCTION

State and Federal Regulations require that each jurisdiction within the State of Washington develop an emergency plan to deal with disasters at the local level.

The purpose of this vulnerability analysis is to provide information on potential hazards whose impacts would go beyond those considered "routine emergencies" within the City of Covington and its surrounding area. It will be separated into two major categories; **Natural and Technological** and will serve as a basis for local emergency planning.

It is unlikely that this analysis will include every hazard, which could occur. Therefore, this document is prepared so that it can be updated, as additional information becomes available.

The information provided in this report is not original, but has been compiled from many publications and other informational sources. It is not presented as a detailed study, but as an overview of potential situations that could occur in our community.

The Public Works and Emergency Management Department expresses its appreciation to the numerous private, local, state, and federal organizations that furnished information for this analysis.

II. GEOGRAPHIC CHARACTERISTICS

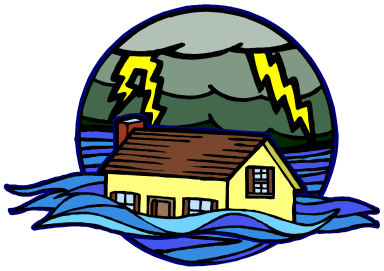
The City of Covington is centrally located on the east hill of a region known as the Puget Sound area. The City of Covington and the greater Covington area encompasses approximately 20 square miles. The Cities of Seattle and Tacoma lie 20 miles to the north and south respectively, with adjacent Cities being Kent on the west and Maple Valley on the east; Auburn on the south; Black Diamond on the southeast; and along with unincorporated King County on the north and south.

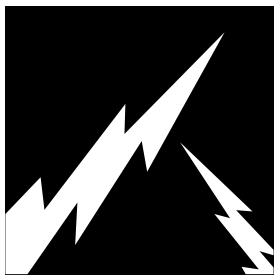
Physical features have defined several geographically distinct portions of the area, notably, the East Hill plateau. Residential development and supporting regional and downtown commercial activity are the predominant make up of these areas, with the major industrial area and southeast industrial district being located on the south side of Covington Way.

Mount Rainier rises majestically to our southeast. The Olympic Mountain range and the Puget Sound bound Covington to our west and the Cascade Mountain range to the East. Numerous small lakes and streams are also located within our area of analysis.

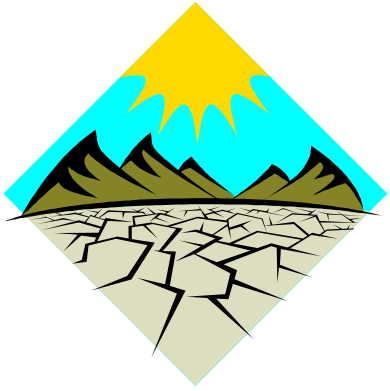
III. DEMOGRAPHIC CHARACTERISTICS

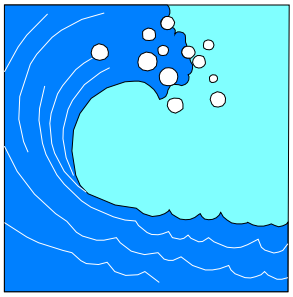
With continued annexations to the city, the 2005 Population Estimate indicates the City of Covington has a population of 16,610 and the Kent Fire Department (contracted to the City of Covington for fire service) having a population of approximately 50,000. The 2005 population of the City of Covington is approximately 16,610 and growing by 500 to 900 per year.





Natural Hazards





DROUGHT

General

Drought is a normal, recurrent feature of climate and occurs almost everywhere. It is a condition of climatic dryness which is severe enough to reduce soil moisture and water below the minimum necessary for sustaining plant, animal, and human life systems.[1] Human beings often exacerbate the impact of drought. The severity of drought is measured by the Palmer Index in a range of 4 (extremely wet) to -4 (extremely dry). The Palmer Index incorporates temperature, precipitation, evaporation and transpiration, runoff and soil moisture when designating the degree of drought.[2]

There is some disagreement over the primary meteorological causes of drought; theories include sunspots, volcanic dust, land alterations, ocean currents, and atmospheric pollutants.

Drought conditions make airborne dust and smoke problems worse than usual. Dust and smoke contain very small particles, called particulate matter, which can cause minor lung irritation.

Drought affects water levels for use by industry, agriculture and individual consumers. Drought also affects power production; much of Covington's power is produced by hydro-electric dams. When water levels drop, electric companies cannot produce enough power to meet demand and are forced to buy electricity from other sources.

History

Listed below are the most significant droughts affecting the Puget Sound lowlands since 1900.[3]

- July/August 1902: No measurable rainfall in Western Washington from July 23 to August 25. Fruit and vegetable crops ripened quicker than expected and hop crops were down in Western Washington.
- August 1919: Drought conditions accompanied hot weather and forest fires. Crop yields were low.
- July 1921: Drought affected all agricultural sections and Northwestern Washington had a large number of forest fires.
- June - August 1922: Statewide precipitation average was only .10 inches. Crop yields were down and 311,483,000 board feet of timber were destroyed by fire.
- July 1925: Crop yields were low and fires burned 142,355 acres.
- June 1928 - March 1929: Most stations averaged less than 20 percent of normal rainfall for August and September and less than 60 percent for the nine month period.
- July - August 1930: The driest weather occurred in Western Washington with weather stations averaging 10 percent or less of normal precipitation.

[1] Washington State Emergency Management Division, Hazard Identification and Vulnerability Analysis, June 1996, p B1.
[2] Governor's Ad Hoc Executive Water Emergency Committee Staff, "History of Drought in Washington State", State of Washington, December 1977, p 7.
[3] information compiled from Governor's Ad Hoc Executive Water Emergency Committee Staff, "History of Drought in Washington State", and Washington State Emergency Management Division, Hazard Identification and Vulnerability Analysis.

- April 1934 - March 1937: The longest drought in the region's history with the Palmer Index maintaining values less than -1. The driest periods were April - August 1934, September - December 1935, and July - January 1936 - 1937.
- May - September 1938: It was the driest growing season ever recorded in Western Washington with nearly all stations reporting less than half normal precipitation levels.
- 1944: July temperatures were above normal in Western Washington and bean yields were down in King County.
- 1952: The hardest hit areas were Puget Sound and the central Cascades. The Palmer Drought Index dropped to a low of -5.06 in the Puget Sound lowlands. The Index was -4 during the winter limiting snow pack reserves for the following summer.
- 1965/1966: The entire state was affected by drought conditions. King County recorded Palmer Indexes of roughly -1.5 from June 1965 to December 1966.
- June - August 1967: No rain fell from the third week in June to the third week in September. 1,767 fires burned throughout the state.
- October 1976 - September 1977: King County experienced precipitation levels 57 percent of normal. Stream flows averaged between 30 and 70 percent of normal, temperatures were higher than normal which resulted in algae growth and fish kills.
- October 1991 - September 1994: Stream flows were between 30 and 60 percent of normal. Agriculture products suffered greatly. Thirty counties were designated as Emergency Drought Impact areas.
- March 14, 2001 - December 31, 2001: Washington State became the first Northwest state to make a drought declaration when Governor Gary Locke authorized the Department of Ecology to declare a statewide drought emergency. The area had experienced several months of record low precipitation and, thanks to above-average precipitation in the final two months of the year, the drought emergency formally expired on December 31 of the same year.

Vulnerability

Covington is vulnerable to drought. In every drought, agriculture has felt the impact, especially in non-irrigated areas such as dryland farms and range lands. Other heavy water users, such as landscapers, are also negatively impacted. Because much of the city's power comes from hydroelectric plants, droughts often cause both water and power shortages. Therefore, heavy power users are also affected.

From the history provided above, it is easy to see how often the area is affected by drought conditions. Drought conditions have differing impacts on the community during different times of the year. A drought during the winter which limits snow pack might have a more severe impact on the community than one in the late summer when reservoirs can be used to mitigate problems. There are also certain times during a growing season when crops are better able to cope with drought conditions than others. Therefore, crop yields can vary greatly depending on when in the growing season the drought occurs.

Effects

It is often difficult to recognize a drought before being in the middle of it. Droughts do not occur spontaneously, they evolve over time as certain conditions are met. Therefore it is difficult to measure the losses and gains due to a drought.

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. Droughts impact individuals, the agricultural industry, and other related sectors. For example, a lack of snowpack has forced ski resorts into bankruptcy. Additionally, there is increased danger of wild land fires associated with most droughts. Millions of board feet of timber have been lost, and in many cases, erosion occurred which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers. (See Fire Hazards section for more information).

Often times drought is accompanied by extreme heat. When temperatures reach 90 degrees and above, people are vulnerable to sunstroke, heat cramps and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well. In past Washington state droughts, wheat has been scorched, apples have sunburned and peeled and yields were significantly lessened.[4]

Conclusion

Throughout the years the impact of droughts on Covington has been lessened through the development of new agriculture and fire fighting techniques. Values are changing, giving more importance to preserving wildlife habitat, aesthetics, recreation, and water quality - all of which create pressure to leave water in rivers instead of using it. The mid 1980's marked the beginning of a new level of public concern for the environment, as people became aware of the possibility of global warming, ozone depletion, the plight of the spotted owl, and plummeting salmon runs in the Pacific Northwest. New ideas such as sustainability and ecosystem management started to become part of our approach to resource management. However, the increasing population and new industries will continue to tap resources and make the area susceptible to drought conditions. Public education programs on water conservation and fire prevention are important for mitigating future losses.

[4] Governor's Ad Hoc Executive Water Emergency Committee Staff, "History of Drought in Washington State", State of Washington, December 1977, p 23.

EARTHQUAKES

General

An earthquake is a naturally induced shaking of the ground. Earthquakes are caused by the fracture and sliding of rock within the Earth's crust. The earth's crust is divided into eight major pieces (or plates) and many minor plates. These plates are constantly moving, very slowly, over the surface of the globe. As these plates move, stresses are built up in areas where the plates come into contact with each other. Within seconds, an earthquake releases stress that has slowly accumulated within the rock, in some instances over hundreds of years. Sometimes the release occurs near the surface, and sometimes it comes from deep within the crust.

In Western Washington, the primary plates of interest are the Juan De Fuca and North American plates. The Juan De Fuca plate moves northeastward with respect to the North America plate at a rate of about 4cm/yr. The boundary where these two plates converge, the Cascadia Subduction Zone, lies approximately 50 miles offshore and extends from the middle of Vancouver Island in British Columbia to northern California. As it collides with North America, the Juan De Fuca plate slides (or subducts) beneath the continent and sinks into the earth's mantle. The collision of the Juan De Fuca and North America plates produces three types of earthquakes.

The first type of earthquake occurs along a subduction fault, as a direct result of the convergence of these two plates. A subduction earthquake would be centered off the coast of Washington or Oregon where the plates converge. Such earthquakes typically have a minute or more of strong ground shaking, and are quickly followed by damaging tsunamis and numerous large aftershocks.

The second type of earthquake occurs within the Juan De Fuca plate as it sinks into the mantle. These are primarily deep earthquakes, approximately 25-100 kilometers in depth. Due to their depth, aftershocks are typically not felt in association with these earthquakes. History indicates that these earthquakes do not occur east of the Cascade Mountains.

The third type are shallow earthquakes that occur within the North America plate. Recent studies have found geologic evidence for large shallow earthquakes along the Seattle Fault 1,100 years ago within the central Puget Sound Basin. Conventional theory being that stress is probably transmitted from the Cascadia subduction fault into the interior of the North America plate. This type of earthquake has occurred throughout Washington, and most parts of Oregon. These earthquakes are primarily shallow with depths of 30 kilometers or less.

History

Each year more than a thousand earthquakes are recorded in Washington State. Fifteen to twenty of these earthquakes are strong enough to be felt. The most recent significant earthquake in our region was February 28, 2001 that was 6.8 magnitude, centered near Nisqually about 48 kilometers (30 miles) deep. Very little damage was reported. No transportation routes were interrupted and no structural damage to homes or businesses occurred that required long term closure of the structures.

No subduction earthquakes have occurred in historic times along the Cascadia Subduction Zone. However, there is geological evidence of enormous (> magnitude 8 - 9) earthquakes occurring approximately every 550 years. The recurrence interval has apparently been irregular, however, with the interval between earthquakes being as short as about 100 years and as long as about 1,100 years. The most recent subduction earthquake was about 300 years ago.

Two earthquakes that caused the most damage in western Washington in the twentieth-century, the 1949 Olympia (magnitude 7.1) and 1965 Seattle - Tacoma (magnitude 6.5) earthquakes occurred within the Juan De Fuca plate. Approximate recurrence intervals for these types of earthquakes of various magnitudes are estimated to be 35 years for magnitude 6.5 and 110 years for magnitude 7.0.

The majority of earthquakes that occur in the Pacific Northwest region are of the shallow kind occurring in the North America plate. For example, the 1872 North Cascades earthquake, the 1945 earthquake near North Bend and the 1981 earthquake on the St. Helens seismic zone were all of this type. Additionally, recent studies have found geologic evidence for large shallow earthquakes along the Seattle Fault 1,100 years ago within the central Puget Sound Basin. Massive block landslides into lake Washington, marsh subsidence and tsunami deposits at West Point in Seattle, tsunami deposits at Cultus Bay on Whidbey Island, and large rock avalanches on the southeastern Olympic Peninsula have all been dated to approximately 1,100 years ago.

Vulnerability

The greatest concentration of earthquakes in Washington occurs in the Puget Sound lowlands and the western Cascade Range (longitudes 121.5 degrees and 123.0 degrees) and from about Olympia to the Canadian borders (latitudes 47.0 to 49.0 degrees). All of King County is included in this area. Therefore, all parts and people of King County are vulnerable to all three types of Pacific Northwest earthquakes.

The potential exists for large subduction earthquakes along the Cascadia Subduction Zone. Researchers say the stresses they observe off the coast of Washington could generate an earthquake measuring 9+ on the Richter scale. This would cause coastal areas to drop up to six feet in minutes and would produce a tsunami all along the fault line from British Columbia to Mendocino, California. Such an earthquake would last several minutes and produce catastrophic damage. As mentioned previously, these earthquakes are believed to occur approximately every 550 years, the last one being approximately 300 years ago.

Deep earthquakes within the Juan De Fuca plate are believed to occur every 35 years. They generally last 20 - 30 seconds and have the potential of reaching 7.5 on the Richter scale. The last major one in the Puget Sound region was the 6.8 magnitude Nisqually Earthquake February 28, 2001.

Shallow earthquakes within the North America plate account for most of the earthquakes in the Puget Sound region. Most are relatively small but the potential exists for major shallow earthquakes as well. It is estimated that the St. Helens seismic zone could produce a magnitude 6.2 - 6.8 earthquake. Additionally, new evidence of a fault running east - west through south Seattle (the Seattle fault) suggests that a major earthquake having a magnitude 7 or greater affected the Seattle area about 1,000 years ago. There are believed to be other similar faults elsewhere in the Puget Sound area but they have not been studied in detail.

Generally, these earthquakes are expected to have magnitudes less than 8 and last between 20 - 60 seconds.

Effects

The principal ways that earthquakes cause damage are by strong ground shaking and by the secondary effects of ground failures, landslides, liquefaction, subsidence, tsunamis (seismic ocean waves) and seiches (rhythmic movements of inland bodies of water). The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling materials. Severe quakes usually disrupt utilities including: power, telephone, gas, sewer, solid waste, and water. The effects of an earthquake in King County are hard to define because of the many unpredictable variables involved. Normally, an earthquake occurring nearer the surface will cause more damage than one occurring at a greater depth.

The time of the earthquake has a large impact on the potential for human casualties. The potential for casualties is greatest during hours of heavy traffic and when large numbers of people are concentrated in schools and business areas. Typically, the twelve - hour period from six o'clock in the morning to six o'clock in the evening has the greatest potential for human casualties. The location and intensity of the earthquake are obviously major factors in determining the effects encountered. Generally, the smaller and shorter the quake the less damage and casualties there are. However, these variables work in conjunction with each other. Consequently, a small earthquake during peak traffic times occurring near a populated area could cause more damage than a large isolated one occurring at night.

Site conditions and the types of soils or rock also affect the amount of shaking and the potential for damage. Solid rock or bedrock does not increase the shaking. However, soft materials such as mud, artificial fill and layers of sand and clay will make the consequences of ground shaking much worse. This is because they increase or amplify the effects of an earthquake. Steep slopes may experience landslides. Floodplains and areas of artificial fill will be prone to liquefaction. This may result in local areas experiencing severe damage, especially where the ground fails under buildings, water mains, pipelines or bridges.

Building materials will greatly affect the impact of an earthquake on a structure; unreinforced masonry structures are the most vulnerable while wood frame structures typically perform well in earthquakes. Additionally, individual buildings have different natural frequencies of vibration that depend on their height and structural design, amplification may affect some buildings more than others. In other words, amplification of frequencies that are near a building's natural frequency can cause resonance and accentuate damage; deamplification of those frequencies would likely lessen damage. Strong shaking is a hazard both near the epicenter of an earthquake and in areas where amplification occurs.

The effects of an earthquake could also vary widely by the buildings and infrastructure first damaged. Damage to buildings that house emergency services such as fire houses and hospitals could lessen emergency response capabilities. Breaks in the street and bridge network can also impair the delivery of emergency services.

Time, location, magnitude and depth of an earthquake will greatly affect the vulnerability of Covington and the greater King County area. A significant portion of land in the County is soft, including sandy, clay-like and artificial fills which makes it more susceptible to ground shaking. Strong earthquakes in King County could trigger collapse or settlement of abandoned coal mines. Additionally, the majority of the county's bridges were built prior to 1960, and therefore

do not meet updated earthquake building codes. An Earthquake Economic Impact Statement developed by FEMA in 1991 indicates that direct and indirect economic losses to Puget Sound from a tremor measuring 7.5 on the Richter scale could total more than $13 billion. (These figures do not reflect economic losses due to casualties.)

Covington's vulnerability in the event of a major earthquake would be damage to the Highway. 18 overpasses at Covington Way SE, SR 516, 180th Avenue SE and SE 256th Street. These are the main East - West and North - South transportation routes. Should the Lake Youngs Dam, just north of the City fail, major portions of Covington would quickly flood. A few residential areas may have landslides, placing some homes and occupants in jeopardy. The natural gas lines running north - south on the eastern part of the City may be subject to rupture.

Conclusion

King County is part of "earthquake country" and therefore earthquakes are one of the most potentially damaging emergencies the County will face. Human and economic losses would accompany any major earthquake in the Puget Sound region. Information from previous major Puget Sound earthquakes may not be capable of assisting in the prediction of losses from future events due to the changes in population and infrastructure since the last major earthquake in 2001. Better predictors may be the Loma Prieta and the Northridge earthquakes of California, which had losses in the billions of dollars. The potential coexistence of other disasters with earthquakes, such as fires, hazardous materials releases, ground failures, landslides, liquefaction, tsunamis and seiches add to the difficulty in predicting losses. These impacts continue throughout the recovery phase due to needed building inspections and damaged infrastructure including transportation routes. Business is often lost to the area due to these factors.

Citizens are expected to be self-sufficient up to 3 days following a major earthquake without government response agencies, utilities, private sector services and infrastructure components. Education programs are currently in place to facilitate the development of individual, family, neighborhood and business earthquake preparedness. Remember, government alone can never make this region fully prepared. It takes individuals, families, and communities working in concert with one another to truly be prepared for disaster.

FIRE HAZARDS

General

The City of Covington experiences three types of fire threats: structure fires, forest fires and wildland/urban interface fires.

Definition of Hazard

Structural Fires: Fires that are not typically considered an emergency, except when the fire can potentially spread to adjoining structures.

Forest Fires: Fires that are the uncontrolled destruction of forested lands caused by natural or human-made wild fire. An average of 905 fires burn 6,488 acres annually with a resource loss of $2,103,884 in Washington State. The probability of a wildfire in any one locality on a particular day depends on fuel conditions, topography, the time of year, wind direction and speed, the past and present weather conditions, and the activities (debris burning, land clearing, camping, etc.) that are or will be taking place. Controlled burns are also conducted because the fire cycle is an important aspect of management for many ecosystems. These are not considered hazards unless they were to get out of control.

Wildland/Urban Interface Fires: Fires that occur where "combustible vegetation meets combustible structures" and therefore combine the hazards associated with both forest and structural fires. These types of fires have increased dramatically in the last two decades as more and more people move to rural areas. Between 1970 and 1980 the rural population of the United States increased 23.4 percent, more than twice the gain of 11.4 percent for the nation as a whole. The hazard is bi-directional, wild fires can burn homes, and home fires can burn into the wildlands.

These types of fires are increasing as more vacation homes are built and improved transportation systems allow more people to live outside city centers. The longer response times for these out of the way locations gives the fire more time to get out of control, making these fires very difficult to fight. Most fire fighters are trained to fight either wildfires or structural

fires. Interface fires require both skills, and it is very difficult to balance the two. "When a wildfire breaks out, the threat of extreme property and casualty losses often forces firefighters to focus their efforts on protecting homes and structures, sometimes at the expense of protecting wildland resources or working to slow the fire itself."

History and Probability of Occurrence in Covington

Structural Fires: The largest conflagration (large multi-structure fire) in King County history is the 1889 Seattle fire, which is estimated to have consumed 60 acres of downtown.

On August 6, 1993, a series of fires began in the north Seattle area. Ultimately, 76 fires occurred, resulting in losses of over $22 million. On February 6, 1993, Paul Keller was arrested and charged with arson. He ultimately pled guilty to setting 32 of the fires.

Fire in any area is a menace to both life and property. During 1996 there were more than 900 reported fire incidents within the Greater Kent Area causing significant monetary loss of property.

Forest Fires: Fire is a normal part of most forest and range ecosystems in temperate regions of the world. Fires historically burn on a fairly regular cycle, recycling carbon and nutrients stored in the ecosystem and strongly affecting the species within the ecosystem. Annual acreage consumed by wildfires in the lower 48 states dropped from about 40 - 50 million acres per year in the 1930's to under 5 million acres by 1970. A Western Washington study showed that modern wildfires are estimated to consume only about a tenth of the biomass each year that prehistoric fires burned.

Wild fires are directly caused by two sources: people and nature. During the period 1977 - 1994 people caused 80 percent of the wildland fires in Washington State while nature caused 20 percent. An average of 905 fires burn 6,488 acres annually with a resource loss of $2,103,884 in the state.

Wildland/Urban Interface Fires: The City of Covington has not experienced a large wildland/ urban interface fire but we are susceptible to fires similar to the Oakland Hills fire. This October 1991 fire killed 25 people, injured 150 others, destroyed 3,354 single-family homes, 456 apartments, and caused $1.5 billion in damages.

Potential Impact and Vulnerability

Structure Fires: In addition to typical methods of occurrence, structural fires are a potential secondary hazard of earthquakes and riots. One study estimated that 80 to 100 fires would occur from a large earthquake in the Seattle area. Building codes requiring fire detectors and sprinkler systems are in effect for most large structures, therefore reducing some vulnerability.

Often, older structures do not conform to modern building and fire codes and do not contain fire detection devices. These structures are also prone to faulty electrical, heating and other utility systems due to age and lack of proper maintenance. Many of these older structures were constructed in very close proximity to one another, enabling fire to spread rapidly from one structure to another. Older apartment buildings and hotels also face increased risk of rapid fire spread due to inadequate firewall protection and the lack of fire detection and sprinkler systems.

Some of the newer residential structures, though still susceptible to high population risk, are not as vulnerable to fire as are older structures. These structures were designed and built to include fire resistive features, which conform to modern fire and building codes. Fire detection and/or extinguishing systems were also installed in these buildings at the time of construction. Though a major fire could certainly occur in these structures, the likelihood of spreading to adjoining structures or units before it can be brought under control is significantly reduced.

Commercial, industrial and multi-family fires present their own unique hazards. Some newer structures, like residential occupancies, are built with fire resistive construction and fire detection and/or sprinkler systems (in buildings over 10,000 sq. ft.) thereby reducing the risk of major fires. Older structures and single-family dwellings, however, share many of the same problems as older housing and are at greater risk of fire.

The storage and use of hazardous materials by commercial and industrial occupancies within the City of Covington, not only increases the risk of fire, but also poses a significant threat to firefighters and the community if they should become involved in a fire.

Forest Fires: The City of Covington's climate includes dry summer months during which the area is susceptible to fires. King County is prone to wildland fires with a fire season that usually runs from mid May through October. However, any prolonged period lacking precipitation presents a potentially dangerous problem as is evidenced by a winter wild land fire that occurred in January 1995 in the Cumberland area of King County.

Wildland/Urban Interface Fires: The City of Covington and surrounding areas are becoming more vulnerable to the effects of wildland/urban interface fires due to increased building, living and recreating in forested areas.

Effects

Structure Fires: Injuries and casualties to the occupants of a structure are a primary concern in all structural fires. These events can also cause the release of hazardous materials and disconnect utility lines.

Forest Fires: The effects of wild land fires vary with intensity, area and time of year. The greatest short-term loss is the complete destruction of valuable resources, such as timber, wildlife habitat, recreation areas, and watersheds. Severe fires producing high soil temperatures create a water-repellent layer below the soil surface. The soil above this layer becomes highly prone to erosion, often resulting in mudslides. Long-term effects are reduced amounts of timber for commercial purposes and the reduction of travel and recreational activities in the affected area. Loss of life and personal property occur as well.

Wildland/Urban Interface Fires: The effects of interface fires are the combined effects of both structure and forest fires.

Conclusion

The following steps should be accomplished to preclude major loss of life and reduce the actual number of forest fires and wildland, or urban interface fires:

- Citizens should know the proper way to handle fire. Public education programs on fire safety, fire alarms and fire response are important. People should also be encouraged to purchase fire insurance and understand building codes.
- The number of commercial and industrial fires in the City of Covington has been controlled in recent years due to the annual fire inspections performed by Kent Fire Department. These inspections not only identify potential problems, they also provide an opportunity for business owners and workers to be more aware of fire prevention through education provided at the time of inspection. Despite the best efforts however, some fires still occur.
- The science and art form of Arson Investigation has also been a significant factor in the reduction of urban fires. Investigators and fire crews are working together to convict and or deter more arsonists than ever before.
- Since people start the vast majority of forest fires, forest fire prevention education and enforcement programs can significantly reduce the total number of wild land fires.
- An effective early fire detection program and emergency communications system are essential. The importance of immediately reporting any forest fire must be impressed upon local residents and persons utilizing the forest areas.
- An effective warning system is essential to notify local inhabitants and persons in the area of the fire. An evacuation plan detailing primary and alternate escape routes is also essential.
- Fire-safe development planning should be done with local government planners.
- Road criteria should ensure adequate escape routes for new sections of development in forest areas.
- Road closures should be increased during peak fire periods to reduce the access to fire-prone areas.

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FLOODS

General

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. It is a natural geologic process that shapes the landscape, provides habitat and creates rich agricultural lands. Human activities and settlements tend to use floodplains, frequently interfering with the natural processes and suffering inconvenience or catastrophe as a result. Human activities encroach upon floodplains, affecting the distribution and timing of drainage, and thereby increasing flood problems. The built up environment creates localized flooding problems outside natural floodplains by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows and increases flow rates downstream.

There are basically three types of floods: 1) a rising flood which occurs because of heavy prolonged rain or melting snow or both; (this type of flood can impact on both rural, suburban and urban areas in King County); 2) flash floods which are characterized by quick rise and fall of flood levels; and 3) wind-driven flood tides that combine wind and tides to flood coastal areas.

There are six major river systems that flow through King County: the Skykomish, Snoqualmie, Cedar, Sammamish, Green, and White. Except for the Sammamish, each of these rivers descends from the crest of the Cascade Mountains to Puget Sound and are therefore heavily influenced by snow and rain patterns in the mountains. These major river systems are some of the County's most magnificent natural resources. They provide recreational opportunities as well as habitat for fish and wildlife. Many communities in King County had their origins along the major river systems. At the same time, the major rivers can be hazardous for residents who live and work in the rivers' broad floodplains.

Covington has no rivers and only three streams that feed the Green River. The streams are Soos Creek, Little Soos Creek and Jenkins Creek. All streams flow in a north to southerly direction. The Soos Creek extends down the western border of Covington, Little Soos creeks origin is Lake Youngs Dam and it joins Soos Creek in the south of the City and Jenkins Creek's headwaters are north of Pipe Lake and the Creek eventually connects to Soos Creek south of the City.

History

Estimates are that roughly a dozen people have been killed by floods in King County since the turn of the century. Most of these people drowned while trying to cross inundated roadways. Property damage caused by floods is a far more widespread problem, however damage estimates are not conducted unless the area is declared a federal disaster area. No recorded fatalities exist within the City of Covington.

The most recent Presidentially declared flood disasters were the November 1995 and February 1996 floods when storm fronts and melting snowpack caused massive flooding throughout Washington and Oregon. During these floods, King County was one of twenty-two counties, which were declared emergencies. All rivers monitored by King County Surface Water Management (SWM) reached Phase 4 flood alerts. The Green River basin had erosion, flooding, slide and debris problems. At one point the City of Auburn's water supply was off line.

Flooding along the Cedar River inundated the Renton airport, impacting airport operations and the Boeing Company. Reservoir storage at Howard Hanson Dam (75%) and Mud Mountain Dam (85%) was at the highest level on record. State Route 169 and the West Valley Highway were closed during the flooding. Other roads were overtopped, isolating communities and causing damage.

The November 1990 - March 1991 floods were also a Presidentially declared flood disaster. During these floods, all river systems in King County reached flood stage with the majority of damage occurring in the Snoqualmie and Cedar River valleys. Flooding in early November had swelled major rivers throughout Western Washington. "Then on November 23, a heavy downpour of warm rain - referred to by local weather forecasters as the 'Pineapple Express' because of its origins in the southern Pacific Ocean - began to fall on a recent snowfall in the Cascades. The resulting runoff from melting snow and rain hit the already saturated floodplains on the next day, leading to the highest flows ever recorded on most of the rivers and streams draining the western slopes of the mountains". In some cases the flows were so high that stream gages reached their maximum height, unable to record any additional flow. More than $15 million in damage was done in King County alone. Nearly 900 homes were damaged or destroyed and two men drowned. Agricultural areas experienced heavy losses, as hundreds of cattle and other livestock drowned; equipment, feed and buildings were inundated. Dozens of roads were impassable during the flood, and numerous streets, bridges, levees and other public property were heavily damaged.

Covington has experienced some overtopping of flood water on SE 256th Street at 148th Avenue SE plus some along Little Soos Creek.

Vulnerability

Flood hazard areas in King County are located on the floodplains of all rivers, streams, lakes, wetlands, and closed depressions. King County normally experiences some degree of Type 1 (rising) flooding on its river and stream systems every year. Types 2 (flash) and 3 (wind driven) floods have not historically been a threat. High water and flooding most commonly occur between October and June, during periods of heavy rainfall or rapid snowmelt. Historically, the Snoqualmie River has been a primary indicator of flooding in King County in that when it floods, other river systems also flood.

FEMA has mapped 139,789 acres of King County that are at risk from inundation during a 100 year flood (a flood that has a one percent chance of occurring in any given year). This is approximately ten percent of the County's total area. Estimates of the number of vulnerable homes in King County range from 4,000 to 18,000 homes. FEMA has mapped some flood areas on Little Soos Creek and Jenkins Creek south of SR 516. They were unable to determine the flood elevations north of SR 516 for Jenkins Creek.

King County has become increasingly vulnerable to urban flooding as well. Population growth leads to more development which extends the amount of impermeable surfaces and therefore urban flooding risks are increased. However, in Covington this controlled development has provided a sound stormwater retention and release system that has come with the development.

Effects

Floods can cause loss of life and great damage to structures, crops, land resources, flood control structures, roads, and utilities. Flood damages in King County and the State of Washington exceed damages by all other natural hazards. These impacts result primarily from two types of hazards created by floods: inundation and bank erosion.

Inundation is defined as floodwater and debris flowing through an area. It can cause minor to severe damage, depending on the velocity of flows, the quantity of logs and other debris they carry, and the amount and type of development in the floodwater's path.

Bank erosion can threaten areas that are not inundated by floods. For example, a home on a high bank, above flood levels, can be undermined by the flood's erosive flows. The amount of erosion at a site depends on its location on the channel, flow velocities, the pattern of debris and sediment accumulation in the channel, and the erodibility of the bank. Some rivers, such as the Tolt, experience sudden and dramatic patterns of bank erosion that can create major course changes during a single flood event. To date this has not become a problem in Covington.

It is important to remember that dangers associated with flooding do not end when the rain stops. Electrocution, structural collapse, hazardous materials leaks, and fire are secondary hazards associated with flooding and flood cleanup.

Conclusion

Citizens in King County and Covington should understand the flood potential of areas in which they elect to live. Normally, flood plain information is available through City and County building permit offices (King County Department of Development and Environmental Services, DDES), and emergency management offices. Covington has a full set of FIRM maps available for public viewing and use by the permit review staff to ensure we protect the new construction from flooding. By law, citizens purchasing property that is located in a flood plain must be notified of that fact. Flood insurance information is available from insurance agents throughout King County, however, only about 14 percent of homes in mapped floodplains are insured against flood losses.

Covington has no Flood Warning or Dam Failure System in place.

LANDSLIDES

General

The term landslide refers to the downslope movement of masses of rock and soil. Landslides are caused by one or a combination of the following factors: change in slope gradient, increasing the load the land must bear, shocks and vibrations, change in water content, ground water movement, frost action, weathering of rocks, and removal or changing the type of vegetation covering slopes.

"By geologic standards, the greater Seattle area landscape is very, very young. Just 14,000 years ago, the land the city sits on was still under 3,000 feet of ice, part of the Ice Age's titanic Vashon Glacier, which extended from Canada to south of Olympia. When the ice melted, sea level rose 300 feet and filled the trough the ice had carved, creating Puget Sound. The region is still witnessing the erosion and settling that has followed that tumultuous episode."

The soil covering much of King County was left behind by the Vashon Glacier and is prone to slides. The top layer, Vashon Till, is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete and can be found to depths up to 30 feet. The next layer, Esperance Sand, is a permeable mixture of sand and gravel. This sits upon an impermeable layer of clay, Lawton Clay, made up of fine sediments and large boulders. It is this boundary between the clay and sand in which sliding occurs; water percolates through the sand and runs laterally on top of the denser clay. "The build up of water pressure floats the sand above the clay creating lubrication for a deep-seated slide."

Landslide hazard areas occur where the land has certain characteristics, which contribute to the risk of the downhill movement of material. These characteristics include:

1. A slope greater than 15 percent.
2. Landslide activity or movement occurred during the last 10,000 years.

3. Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable.
4. The presence or potential for snow avalanches.
5. The presence of an alluvial fan which indicates vulnerability to the flow of debris or sediments.
6. The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

History

Recently we have seen the power of landslides as a secondary hazard associated with the severe winter storm that hit the Puget Sound region in December 1996 and January 1997. Heavy snow storms were followed by a warming trend that caused quick melting, runoff and flooding. This period was then followed by rain. This lead to over 100 slides in King County over the subsequent two month period. Major slides causing damage included:

- A slide on Camano Island knocked six homes into Puget Sound. A slide on Bainbridge Island killed a family of four when it pushed their home into Puget Sound.
- A slide along Auburn's Black Diamond Road closed the road for months. Magnolia Bridge supports were knocked out by a slide measuring 300 feet across. The estimated cost of repair is $5 million. (Unrelated slides in Bremerton closed two bridges.)
- A slide in Snohomish near the King County border pushed five freight cars into Puget Sound, debris covered 200 feet of railroad track and extended 900 feet into the water.
- Train service was also canceled for two days over Steven's Pass when a 75-foot wide landslide covered the railroad tracks 6 miles east of Skykomish. It was discovered when a freight train struck the debris and was derailed. (This stretch of track normally sees 24 trains a day).
- Major slides caused evacuations throughout the County including Perkins Lane in the Magnolia neighborhood, Avondale Road in Northeast Redmond, Delridge, and West Seattle.
- Soil slippage is also being blamed for a pipeline explosion in Cowlitz County. King County was also hard hit by landslide damage in 1972. Damages resulting from numerous landslides totaled $1.8 million. Seventy percent of the slides occurred over a two day period in which more than 1.75 inches of rain fell in 24 hours. To make matters worse, this period was preceded by a cold spell, which lowered the absorption capabilities of the soil. The Seattle area was particularly hard hit due to urbanization and geologic conditions.

Vulnerability

Commonly, downslope movement is only considered a hazard when it threatens people and property. Therefore, this discussion focuses on landslides that occur in areas affecting human life or property; rather than landslides that occur in wilderness areas.

Although landslides can and do occur in almost any part of the state, the most vulnerable areas are the Puget Sound Basin and King County. Due to the high population density and the fact that many structures are built either on top of or below bluffs and slopes subject to landsliding, more lives are endangered and there is a greater potential for damage or destruction to private and public property.

Covington has few areas within it's boundaries that are prone to landslides. Homes in a few residential neighborhoods may be vulnerable to landslides. Only a few roads appear to be subject to minor slide damage. Some surface roads and railroad tracks on the outskirts of the City limits could be vulnerable to minor slides.

Many of the major valleys and shoreline bluffs of Puget Sound are bordered by steeply sloping unconsolidated glacial deposits that are highly susceptible to landslides. Other vulnerable areas include the Cascade Mountain passes leading to eastern Washington. There are no similar formations within Covington.

A study in the early 1970's showed that this area is most vulnerable to landsliding in the winter and spring. Generally significant landsliding follows periods of above average precipitation over an extended period, followed by several days of intense rainfall. It is on these days of intense rainfall that slides are most likely.

The Washington State Department of Transportation spends millions of dollars each year to repair damage caused by slope failures. These slope failures vary from a few rocks falling on to the highway, which work crews can remove in minutes, to a major landslide, that may require months of work and millions of dollars to correct. Some slopes fail year after year; others fail once in 50 years.

Effects

Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. Damages to highways alone cost $1 billion annually.

Typical effects include damage or destruction of portions of roads and railroads, sewer and water lines, homes and public buildings. Disruption of shipping and travel routes result in losses to commerce. Many of the losses due to landslides may go unrecorded because no claims are made to insurance companies, lack of coverage by the press, or the fact that transportation network slides may be listed in records simply as "maintenance". Even small scale landslides are expensive due to clean up costs that "may include debris clearance from streets, drains, streams and reservoirs; new or renewed support for road and rail embankments and slopes; minor vehicle and building damage; personal injury; livestock, timber, crop and fencing losses and damaged utility systems".

Conclusion

Landslides are often a secondary hazard related to other natural disasters. Landslide triggering rainstorms often produce damaging floods. Earthquakes often induce landslides that can cause additional damage. The identification of areas susceptible to landsliding is necessary to support grading, building, foundation design, housing density, and other land development regulations in reducing the risk of property damage and personal injury. The most significant effect of landslides is the disruption of transportation and the destruction of private and public property. Some work has been done to prevent developments on top of or below slopes subject to sliding. Much more needs to be done to educate the public and to prevent development in vulnerable areas.

SEVERE LOCAL STORMS

General

Covington, Washington is subject to various local storms that affect the Pacific Northwest throughout the year, such as wind, snow, ice, hail and potentially tornados. Although rare, tornados are the most violent weather phenomena known to man. Their funnel shaped clouds rotate at velocities of up to 500 miles per hour and generally affect areas of ¼ to ¾ of a mile wide and seldom more than 16 miles long. Four tornados have been sighted in King County since 1950.[5] Weather conditions that produce tornados also manifest themselves as less violent phenomena, the severe windstorm, which King County encounters more frequently.

Snowstorms or blizzards, which are snow storms accompanied by blowing wind or drifting snow occur occasionally both in Washington State and King County. As exemplified in the Holiday Blast storm of 1996 - 1997, snowstorms can also be associated with other natural hazards such as flooding and landslides given the right conditions. An ice storm can occur when rainfalls out of warm moist upper layer of atmosphere into a cold, dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces. If this is accompanied by wind, damage can occur to trees and utility wires.

Hailstorms occur when freezing water in thunderstorm type clouds accumulate in layers around an icy core. Wind added to hail could batter crops, structures and transportation systems.

History

The most recent severe storm to affect King County, and the City of Covington occurred over a multi-day period during the end of December 1996 and beginning of January 1997. This storm shows the potential hazards that can be associated with major storms both primary weather related hazards and secondary hazards including its impacts on infrastructure. This storm, referred to in the media as the Holiday Blast, was a series of three weather fronts that included severe snow and ice followed by quick melting and runoff, causing flooding and landslides.[6] Forecasters had not expected the magnitude of the storm.

- December 26, 1996: eight inches or more fell on most areas of the Puget Sound region. Cross state highways and passes were closed, Greyhound cancelled all trips going east over the Cascades for days, garbage collection was postponed a week, SeaTac was not closed but was affected by numerous flight cancellations and delays and influenced by airport closures up and down the west coast. Puget Power had 122,000 customers without power. (This all occurred without setting a snowfall record in the region).
- December 27, 1996: More snow and ice. Trees fell, power lines were severed affecting traffic lights and gas station pumps. The Tacoma Narrows Bridge was closed due to the dangers of icicles falling off suspension cables.
- December 29, 1996: Heavy rains fell on more than a foot of snow. The heavy wet snow caused carports and marina roofs to collapse; 270 boats in an Edmonds marina were sunk. In Woodinville the roof of a horse arena collapsed; no people or animals were

[5] McDonald, Terrance J, "Tornadoes", Seattle: A Hazard Vulnerability Analysis, Master's Thesis, Cornell University, 1995, p 159.

[6] "Holiday Blast: King 5 News Special Report", Television News Special recapping the Storms, Friday January 4, 1997 8 pm – 9 pm.

injured. Floating homes were listing, some taking in water. Interstate 5 was totally closed southbound and restricted to one lane northbound due to flooding as a result of ice clogging storm drains.

- December 30, 1996: Flooding continues. Roads begin to collapse; the Shoreline sinkhole opened up. Many residents are evacuated from their homes. All three mountain passes are still closed.
- December 31, 1996: Flooding continues and mudslides become more prevalent. Magnolia's Perkins Lane has its first home affected; its knocked off its foundation. Raw sewage raises health concerns in Seattle, Bothell, Redmond Auburn and other areas where storm drains are connected to sewer systems.
- January 1 through 3, 1997: Landslides and flooding continue to be the primary hazards. A Burlington Northern train is derailed when land on the bluff above it gave way, the Magnolia Bridge was damaged.
- January 19, 1997: A family of four dies in a mudslide on Bainbridge Island when their house is pushed into Puget Sound.
- Estimated total losses at $31 million of private damages and $41 million of public damages.

The City of Covington (then unincorporated King County), and the western part of the Puget Sound region were also heavily impacted by the windstorm that struck on January 20, 1993, Inauguration Day. High winds caused tremendous destruction of public and private structures, power and telephone lines, and trees; South King County was particularly hard hit.[7] Over 280,000 of Puget Power's King County customers were without electricity; damages to Puget Power facilities were estimated around $17 million.[8]

Six other major windstorms have occurred in Western Washington since 1945. The Tacoma Narrows Bridge (1940) and Hood Canal Bridge (1979) were blown down during two of these storms. However, the most severe windstorm to affect this region was the 1962 Columbus Day storm. Sustained winds over 85 mph were recorded; 46 people died and 53,000 homes were damaged throughout the region.[9]

Vulnerability

All areas of Covington, and the Puget Sound Region, are vulnerable to the various severe local storms except for dust storms, which occur east of the Cascades in the dryer areas of the state. Western Washington has had an average of 11.4 inches of snowfall annually over the past 30 years. The snowfall records in the region are:

- The one day record is 21 inches in January 1950;
- The one month record is 57 inches during January 1950; and
- The winter long record is 67 inches during the winter of 1968 - 1969.[10]

This shows that Covington is quite vulnerable to the affects of snow and ice each winter. Windstorms can and do occur throughout the year and often cause the same general effects. The current utilization of above ground utility lines increases the vulnerability to widespread

[7] Leovy, Jill, "Southeast King County is Hard Hit; Death, Injuries and Widespread Outages", Seattle Times, January 21, 1993.
[8] Williams, Scott, "Windstorm was Worst Ever for Puget Power", Seattle Times, January 27, 1993.
[9] McDonald, Terrance J, "Windstorms", Seattle: A Hazard Vulnerability Analysis, Master's Thesis, Cornell University, 1995, p 181.
[10] "Holiday Blast: King 5 News Special Report", Television News Special recapping the Storms, Friday January 4, 1997 8 pm – 9 pm.

utility outages during these weather events (See Energy Shortages and Utility Outages for more detailed information). Additionally, people in transit are considered the most vulnerable group because mobility is often rapidly reduced trapping people without the necessary resources. Staying home when such events are forecasted is typically the wisest course of action.

Effects

The general effects of most severe local storms are immobility and loss of utilities. Transportation routes can get blocked, travelers and commuters can get stranded, and families can be separated. Additionally, because electrical lines are damaged, other utilities such as telephone systems (cell and land lines), natural gas, water and sewer systems can become inoperable. Physical damage to homes and facilities can occur from wind damage, accumulation of snow, ice, and hail from accompanying winds. Even a small accumulation of snow can cause havoc on transportation systems due to a lack of snow clearing equipment and experienced drivers.

Conclusion

Severe local storms are probably the most common widespread hazard. They affect large numbers of people throughout the City of Covington, and region when they occur. These types of storms can quickly overwhelm city and county resources. Citizens should be prepared for these types of storms: family plans should be developed, disaster kits should be put in homes, workplaces, schools and cars and every family member should be taught how to shut off household utilities. Initiating early dismissal from schools and business is an effective mitigation measure and should be encouraged.

VOLCANOES

General

A volcano is a vent in the Earth from which molten rock (magma) and gas erupts. The molten rock that erupts from the volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles.

The Cascade Range is a 1,000 mile long chain of volcanoes which extends from northern California to southern British Columbia. Many of these volcanoes have erupted in the recent past and will erupt again in the foreseeable future. Eruptions in the Cascades have occurred at an average rate of 1-2 per century during the last 4,000 years. The U.S. Geological Service (USGS) classifies Glacier Peak, Mt. Adams, Mt. Baker, Mt. Hood, Mt. St. Helens, and Mt. Rainier as being potentially active Washington state volcanoes.

Hazards that Can Occur With or Without an Eruption

In addition to the hazards associated with volcanic eruptions (defined as magmatic activity), volcanoes can also produce nonmagmatic hazards. The USGS differentiates between these two types of volcanic activity because the movement of magma can usually be detected through volcano monitoring; therefore there is generally some warning prior to a magmatic event. In the case of nonmagmatic events, such as the generation of debris flows, there is generally no movement of magma and an event may not be detected until it occurs. Thus volcanic activity not directly related to an eruption also poses a serious threat.

1. Debris Flows (also called mud flows) are dense mixtures of water saturated debris that move down valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move downslope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods. This danger continues for months, even years following an eruption.

   A volcanic mudflow, whether or not related to an eruption, is called a “lahar” which can be hot or cold. Lahars move faster on steep slopes nearest their source and attain speeds greater than ordinary floodwaters downstream. The average speed is between 15 and 60 mph. The highest speed measured on the slopes of Mt. St. Helens during the 1980 eruption was 88 mph and the lowest, in the lower valleys, was about 2.5 mph. They may attain depths of hundreds of feet in the canyons near their point of origin but spread out over valleys and low ridges downstream. Debris flows can erode the sides of river channels causing bank failures. Buildings, roads, water pipes, or bridge abutments built along those banks may then be incorporated into the debris flow. A very large volume lahar may even overtop or destroy a dam. The mudflows that accompanied the Mt. St. Helens eruptions “damaged or destroyed more than 200 buildings, ruined 44 bridges, buried 27 km of railway and more than 200 km of roadway, badly damaged three logging camps, disabled several community water supply and sewage disposal systems and partly filled channels and reservoirs”.

2. Volcanic landslides and debris avalanches of glacial ice or rock debris may be set in motion by explosions, earthquakes, or heat-induced melting of ice and snow. They can occur with or without an accompanying magmatic event. Landslides are defined as the downward and outward movement of slope forming materials, natural rock, snow, glacial ice, soils or any combination of these materials. Debris avalanches are a type of landslide that move at high speeds. Many debris avalanches will, if they contain sufficient water and fine sediment, transform downstream into debris flows. Therefore the down-valley hazards associated with debris avalanches are the same as those associated with debris flows; the main hazard to life and property being burial and impact.

3. Explosion of steam and other gases may occur any time hot material comes into contact with water, glacial ice or snow. No eruptive activity is necessary for this to occur. These explosions often contain or are accompanied by one or more of the following: pulverized lava and rock particles in suspension, fragments of older rocks from pea sized pebbles to hundred-ton boulders, newly erupted hot lava "bombs" or blocks, and a shock wave that may be minimal or may extend for several miles.

4. Pockets or clouds of toxic gases may develop on or near both active and inactive volcanoes. Their chemical poisons can cause internal and external burns, or asphyxiation through oxygen starvation. Carbon dioxide, an example of an asphyxiant, is heavier than air and therefore collects in low lying areas. It is difficult to detect because it is both odorless and colorless. These gases, mixed with ash, make up the eruptive cloud of a volcano.

Hazards Associated with the Eruption of Volcano

1. Ashfall normally accompanies the eruptions of volcanoes in the Cascades. These volcanoes tend to erupt lavas so thick and charged with gases that they explode into ash rather than flow. A one inch deep layer of ash weighs an average of ten pounds per square foot causing danger of structural collapse. Ash is harsh, acidic, gritty, and smelly. Ash may also carry a high static charge for up to two days after being ejected from a volcano. Although the gases are usually too diluted to constitute danger to a person in normal health, the combination of acidic gas and ash may cause lung problems. Extremely heavy ash can clog breathing passages and cause death. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with water to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat. Hydrochloric acid rains have also been reported. Acid rains may affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric.

   Heavy ashfall blots out light. Sudden heavy demand for electric light and air conditioning may cause a drain on power supplies, leading to a partial or full power failure. Ash clogs machinery of all kinds and poses a serious threat to aviation because particles can damage aircraft systems and jet engines. It drifts into roadways, railways, and runways where it is slippery and dangerous. Its weight may cause structural collapse. Because winds and air currents easily carry it, it remains a hazard to machinery and transportation (particularly aviation) for months after the eruption.

2. Lava flows are coherent masses of hot, partially molten rock that flow downslope; generally following valleys. Lava flows from the Cascade volcanoes tend to be short and slow-moving. They may extrude from the main volcanic cone or from nearby cinder cones formed at or near the base of the mountain. The heat of the lava burns vegetation, potentially causing forest or grass fires. Flows may bury roads or other escape routes. Lava flows that move over snow and ice can produce debris flows. Because lava flows are slow moving and take predictable paths, they generally pose little threat to human life, however, they will destroy structures and property in their paths. Additionally, their secondary effects such as debris flows and forest fires can threaten life and property.

3. Volcanic earthquakes, often centered within or beneath the volcano, are usually one of three kinds: pre-eruption earthquakes caused by explosions of steam or underground magma movements, eruption earthquakes caused by explosions and collapse of walls inside the volcano, and post-eruption earthquakes caused by the retreat of magma and interior structural collapse.

   Although volcanic earthquakes are strong near the volcano, they are generally confined there. There are some exceptions, as with the "St. Helens Fault Zone," where a tectonic fault is closely associated with the volcano. Tremors may cause large rockfalls, snow avalanches, landslides, and building collapse. Since all Northwest volcanoes are in a regular seismic zone, tremors are monitored by the USGS and the University of Washington Seismology Lab.

4. Pyroclastic flows and surges can also occur during explosive eruptions. Pyroclastic flows are avalanches of hot ash, rock fragments and gas that move at high speeds down the sides of a volcano during explosive eruptions or when the edge of a thick, viscous, lava flow or dome breaks apart or collapses. Such flows can be as hot as 800 degrees Celsius and are capable of burning and destroying everything in their paths. Pyroclastic surges are more energetic and thus less restricted by topography; they can move over ridge tops. Pyroclastic flows and surges are extremely dangerous. Injury or death can result from a number of factors including burial, impact, burning and asphyxiation. Although Pyroclastic flows move down valleys like lava and debris flows, the immediate hazards associated with them are very different. In the case of lava flows, one can usually out run the advancing front. In the case of debris flows, one can climb quickly up the valley sides to a height above the debris flow. In the case of pyroclastic flows and surges, however, the high mobility associated with these flows threatens anyone nearby, such that ridge tops and valley slopes may be unsafe.

5. Lateral blasts are explosive events in which energy is directed horizontally instead of vertically from a volcano. They are gas charged, hot mixtures of rock, gas and ash that are expelled at speeds up to 650 mph. Lateral blasts vary in size, but large ones are fairly rare, with only a few historic examples known worldwide, the most recent occurred during the 1980 eruption of Mt. St. Helens when almost everything within the blast zone perished.

Types of Eruptions

A volcano may exhibit different styles of eruption at different times, and eruptions may change from one type to another as an eruption progresses. The least violent type of eruption is termed "Hawaiian" and is characterized by extensive fluid lava flows from central vents or fissures and are occasionally accompanied by lava fountains. Strombolian eruptions are characterized by moderately fluid lava flows, usually accompanied by a violent lava fountain that produces an abundance of volcanic bombs and cinders. Vulcanian eruptions are characterized by viscous magmas that form short, thick flows around vents; very viscous or solid fragments of lava are violently ejected from these vents. Pelean eruptions are similar to Vulcanian eruptions but have even more viscous lava; domes form over the vents, and ash flows commonly accompany the dome formations. The most violent eruptions, such as that of Mt. St. Helens in 1980, are termed "Plinian" after Pliny the Elder, who died in the Vesuvius eruption of AD 79. They include the violent ejection of large volumes of volcanic ash, followed by collapse of the central part of the volcano.

History

On May 18, 1980, Mt. St. Helens erupted with an explosive force killing 57 people. Heavy ashfall blanketed much of eastern Washington. Subsequent eruptions on May 25 and June 12 similarly affected western Washington and Portland, Oregon, although to a lesser degree.

This was only the most recent eruption of Cascade volcanoes. The table below summarizes the history of volcanic activity for all Cascade volcanoes in Washington State.

Summary of Cascade Volcano Eruptions

Volcano Number and Type of Eruptions

Mt. Adams:
3 in the last 10,000 years, most recent between 1,000 and 2,000 years ago, andesite lava.

Mt. Baker:
5 eruptions in past 10,000 years, mudflows have been more common (8 in same time) pyroclastic flows, mudflows, and ashfall in 1843.

Glacier Peak:
8 eruptions in last 13,000 years, pyroclastic flows and lahars.

Mt. Rainier:
14 eruptions in last 9,000 years, also 4 large mudflows, pyroclastic flows and lahars.

Mt. St. Helens:
19 eruptions in last 13,000 years, pyroclastic flows, mudflows, lava and ashfall.

Vulnerability

Assessment of volcano hazards is based on the philosophy that future volcanic activity is most likely to be similar to what has happened in the past. Records of prehistoric eruptions and events are preserved in the deposits they produced. Such deposits can be mapped, studied and dated in order to learn about the types and frequencies of past events and then used to identify areas that could be affected by future events.

In terms of their potential effects, debris flows constitute the greatest hazard to surrounding communities including King County. Because various processes, both eruptive and non-eruptive, can generate debris flows and because they can travel such distances, they are the most far reaching and common hazard associated with snow and ice covered volcanoes. The major hazard from debris flows to life and property is burial or impact. Because debris flows follow existing drainages, the risk tends to decrease with distance downstream and with height above the river channel.

Mt. Rainier: Is the closest volcano hazard to King County. The volcano is located about 35 kilometers southeast of the Seattle - Tacoma metropolitan area. Rivers draining Mt. Rainier empty into Puget Sound, which has two major shipping ports, and into the Columbia River which is a major shipping lane. This vulnerable area is also home to millions of people in Washington and northwestern Oregon. Although considered an "active" volcano, Mt. Rainier has not been active since the late 1800's when minor eruptions occurred. If it erupts, Mt. Rainier will have the normal eruption hazards and ashfall. Seismologists from the University of Washington and USGS believe that debris and mud flows are the principal threat to King County citizens and property. Mt. Rainier lahars and debris flows have the potential to destroy dams on the White and Green rivers, as well as to significantly disrupt the economy of the Auburn/Kent valley as far north as Tukwila.

Glacier Peak: Is located in Snohomish County approximately 40 miles North of the King/Snohomish County border. Glacier Peak has produced larger and more explosive eruptions than any other Washington volcano except Mt. St. Helens. Its largest eruption expelled more than three times as much ash as the 1980 eruption of Mt. St. Helens. Approximately 13,000 years ago, dozens or perhaps hundreds of lahars churned down the White Chuck, Suiattle, and Sauk rivers, completely inundating valley floors. They then flowed down the Skagit and Stillaguamish rivers as far as Puget Sound. At Arlington, more than 60 miles downstream, lahars from these eruptions deposited more than 7 feet of sediment. The total number of eruptions produced by Glacier Peak in the last 14,000 years, both big and small, makes it one of the most active Cascade volcanoes; yet it produces big eruptions relatively infrequently. Glacier Peak's most recent eruption was around the eighteenth century.

King County is most vulnerable to ash from a Glacier Peak eruption. The stream channels are unlikely to bring debris flows into this county. However, given the proper wind movements, King County could be covered by ash from this close volcano.

Mt. St. Helens: Is located in southwestern Washington and is the most active and most explosive of Washington's volcanoes. In the last 515 years, it is known to have produced four major explosive eruptions; two of which were separated by only two years. An eruption approximately 500 years ago was about five times larger than the 1980 eruption and even larger events are believed to have occurred in the volcanoes 50,000 year lifetime. The volcano is still capable of producing ash, lava flows and lahars. However, neither a large debris avalanche nor a major lateral blast like those of May 18, 1980 is likely now that a deep, open crater has formed. King County residents are still vulnerable to complications arising from volcanic ash that would result from future eruptions of Mt. St. Helens.

Mt. Baker: Is located about 50 kilometers due east of Bellingham. After Mt. Rainier, it is the most heavily glaciated of the Cascade volcanoes. Historic records note several explosions during the mid 19th century. However, geologic deposits indicate that Mt. Baker has not had highly explosive eruptions like those of Mt. St. Helens or Glacier Peak, nor has it erupted frequently. The most frequent and destructive events at Mt. Baker have been debris flows and

debris avalanches, most of which were not related to magmatic events. Because Mt. Baker is not highly explosive and the fact that debris flows from the volcano would not reach King County, it does not appear that King County is vulnerable to volcanic activity at Mt. Baker.

Mt. Adams: Is located in southwest Washington. Although Mt. Adams has not erupted within the past 6,800 years, scientists believe those post glacial eruptions and weak, diffuse emissions in the summit area suggest that the volcano is capable of erupting again. As with Mt. Baker, however, geologic deposits show no sign of highly explosive eruptions in the volcano's past. Numerous debris flows generated by glacial and meteorological processes occur frequently at Mt. Adams, but typically affect areas within only a few kilometers of the volcano. Because of these characteristics it is not likely that volcanic activity at Mt. Adams will affect King County.

Effects

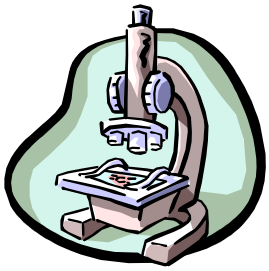
The general effects of volcanic activity was discussed previously. The degree of hazard, however, depends on the kind of eruption and proximity to the vent. Most volcanic dangers are to persons in the near vicinity of the volcano. Other dangers, such as mudflows and ashfall, may exist many miles downstream and downwind. Economic losses from volcanic activity could be enormous. For example, Portland lost $5,000,000 when its port closed after Mt. St. Helens erupted.

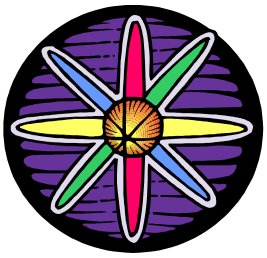
Conclusion

Volcanic activity at Mt. Rainier is believed to pose the greatest threat to King County and its residents. Because of the inactivity of Mt. Rainier, people have tended to settle both on its slopes and along the paths taken by lahar and mudflow drainage. If Mt. Rainier becomes active and erupts or has large lahars and mudflows, all human life and property located on its slopes and along its drainage systems (rivers) are potentially vulnerable.

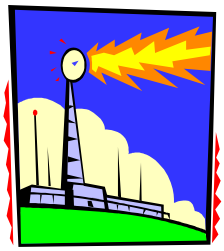
Explosive eruptions at Glacier Peak or Mt. St. Helens would produce ash that would pose health concerns for residents as well as damage property and cause major problems for transportation, local industry, communication and utilities. Non-magmatic events or quiet eruptions at other active Cascade volcanoes would not directly impact King County. However, residents of this County could be vulnerable if visiting a volcano during volcanic activity.

Research continues to find methods to predict volcanic eruptions accurately. Indications that an eruption may be imminent include swarms of small earthquakes as the magma rises up through the volcano, increases in sulfur dioxide emissions, and physical swelling of mountain slopes. The USGS is currently experimenting with a variety of sensors on Mt. Rainier in order to attempt predictions. While these methods have not been perfected, scientists were able to predict the eruptions of Mt. Pinatubo in the Philippines and Mt. Unzen in Japan.





Technological Hazards (Human-Caused)



CIVIL DISORDERS

General

The United States has a long history of civil disorders and civil unrest. Unlike other large scale emergencies that bring communities together, civil disorders tend to be divisive. Since the 1960's, this division has primarily been along racial lines. These types of disorders have been classified as "communal" riots because they are direct battles between two or more ethnic groups. We have also seen "commodity riots" which stress the economic and political distribution of power among groups. Congressional Commissions in the 1960's attempted to categorize civil disorders based on size of crowds, the length of the violence, its intensity, and the level of force needed to restore order. With this information, they established a ranking of major, serious and minor.

History

King County does not have an extensive history of civil disorders; of the events that have occurred here, none would be classified as major (based on the above criteria). The events that have occurred in the County have occurred in Seattle. (Most civil disorders do occur in large cities).

The most recent civil disorder in Seattle was the Fat Tuesday Riot. This consisted of a crowd of disorderly young White people, most of them in their teens and 20's, engaging in some serious vandalism. The occasion for the riot was the end of Mardi Gras, so-called Fat Tuesday, the last day before Lent. Lent is traditionally a period of abstinence and fasting for Christians, and so Mardi Gras is typically a period of feasting and partying. There had been some rowdiness, hooliganism and vandalism in Seattle during the previous two or three nights of Mardi Gras celebrations, but nothing like the riot on Fat Tuesday. Police officials estimated the total number of people milling around late Tuesday night at 9,000, and there were 350 policemen waiting on the edge of the crowd to keep things from getting out of hand.

Another civil disorder incident involved the World Trade Organization (WTO) Riots in November 1999. This began with protests by over 1,000 people in the streets of Seattle who challenged the dominance of free trade policies by attempting to shut down the World Trade Organization talks, ultimately causing disruption, which quickly became a riot.

Seattle also experienced rioting during the late 1960's and early 1970's; although most of it was classified as minor.

Civil rights campaigns, and Boeing layoffs and/or any other major employment industry could produce civil disturbances that may affect the Covington area.

Covington has no actual history of civil disorder at this time.

We can also learn from the experiences in other communities. Los Angeles has an extensive history of urban riots. Los Angeles was the most heavily impacted community by the Rodney King verdict in 1992 "...the dozens dead, the thousands injured and arrested, the massive destruction throughout the city that left more than 1,200 businesses destroyed". Prior indicators of urban violence in Los Angeles included the Watts riots and fires in 1965, which killed 34 people.

The last decade has also seen increased rioting and looting occurring as a response to community sports teams winning championships.

Vulnerability

King County is definitely vulnerable to civil disorders. The area most highly vulnerable is the City of Seattle but as other cities grow, they too will become more susceptible to civil disorders. The County is vulnerable to disorders resulting from a controversial arrest or verdicts. The County is also vulnerable to rioting and looting in response to a Seattle sports team winning a Championship. In this type of rioting it would appear that Pioneer Square and the Seattle Center areas are most vulnerable due to the concentration of fans in these areas for sporting events.

The likelihood of civil disturbances increases daily, given the fact that gang members formerly staking their territory in large cities like Los Angeles and San Francisco, have migrated north to Seattle and have since moved into the Covington area. Other groups with extremist viewpoints are also of concern. Many of these groups have chosen to locate in mid-size cities, both in the Northwest and across the country.

Covington, as well as any other city, could possibly show vulnerability to civil unrest with the occurrence of any of the following circumstances:

1. Large groups of people attending sporting events.
2. Large groups of people attending events such as Covington Days.
3. A protest held at the high school by students and citizens.
4. An act by law enforcement seen as unfavorable by a segment of the community.
5. A City Council decision could cause a demonstration or a civil disorder.
6. The possibility of war could cause issues showing disagreement, displeasure or possibly walkouts.
7. Demonstrations at the BPA Substation regarding an action caused by the Department of Energy.

Effects

Looting is the most common activity associated with civil disorders. Fire setting is also quite common and can quickly spread due to slow response times of overwhelmed fire departments.

Transportation routes can become blocked making it difficult for non-rioters to leave the area and difficult for emergency response personnel to arrive. Seattle's experience with civil disorders indicates violence focused on property rather than on people; but this pattern may not continue.

A civil disorder could cause an economic impact on the businesses in Covington.

Mutual aid could reduce the City of Covington's civil disorder resources, thereby causing further disorder in the community.

Conclusion

The ability to respond quickly is paramount in these situations. Therefore, emergency response agencies should plan and train for these types of events. They should also be able to predict the types of events that have the highest potential for getting out of control and be in a standby position. Los Angeles was caught off guard for the Rodney King verdict because no one suspected the verdict that was handed down. Communities should learn from the experiences in other jurisdictions.

In the event a civil disturbance should occur, it would likely require crowd control measures by law enforcement agencies and the need for rescue and medical aid. Complications of this type of occurrence are injuries, property damage, traffic congestion, inaccessibility to the area involved and the possible need to impose a curfew or evacuate area residents.

The City of Covington, Police Department Officers (King County Sheriff's Office Contract), have been trained and continues training with respect to riot tactics and how to respond in this type of situation.

DAM FAILURES

General

87 dams in King County impound 10 acre feet or more of water. The Washington State Department of Ecology classified eight of these dams as having a high downstream hazard potential (defined as a population at risk of more than 300). Conversely, 48 of these have a low hazard potential (population at risk of zero). The greater Covington and surrounding area is home to 1 of these dams located on Lake Youngs.

History

National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.

On average, Washington State experiences a dam failure approximately once every two years. The majority of these failures are in whole or in part the result of a failure to perform adequate maintenance and monitoring of the facilities. Three incidents have occurred in King County; accounting for all lives lost due to dam failure in the state.

1918: Masonry Dam near North Bend had excessive seepage, which caused a mudflow, destroyed a railroad line and damaged the village of Eastwick; no lives lost.

1932: Eastwick railroad fill failed. A slide caused railroad fill to back up and fail, destroyed a railroad line and damaged the village of Eastwick; 7 lives were lost.

1976: Increased discharge from Mud Mountain Dam caused a surge in flow killing two children playing in the White River near Auburn.

Vulnerability

Lake Youngs, located just north of the City limits of Covington is a reservoir, built and operated by the City of Seattle Department of Public Utilities. Several dikes and levees around its perimeter form the reservoir. The lakes south dam is an earthfill structure with a height of 30 feet, width of 21 feet and total crest length of 1,420 feet. It was constructed in 1921; its last major inspection was in 1997 with minor repairs completed in 1999. Seattle Public Utilities perform the dam's routine inspections and maintenance on a regular basis. This south end dam meets current geotechnical and hydrologic engineering standards.

Failure of these dikes or levees could have catastrophic effect on people and property in the immediate down stream area. Failure of the south end dam will cause flooding in the area of Covington, Auburn and Kent.

King County has four major dams that would cause a countywide emergency if they should fail. These dams are located on the Tolt, Cedar, White, and Green rivers. Certain areas of King County would also be adversely affected by failures of the White River Project located in Pierce County or the Jackson Project located in Snohomish County. Additionally, localized problems could occur if one of the minor dams in the county failed.

Effects

Loss of life and damage to structures, roads, utilities and crops may result from a dam failure. Economic losses can also result from a lowered tax base and lack of utility profits. These effects would certainly accompany the failure of the Lake Youngs outlet dam and other major dams in the King County Area.

This section describes each major dam in the Covington and King County area and the effects its failure would have on Covington. This section is based on studies, which assume a complete dam failure that occurs quickly. In an actual emergency, other failures or partial failures could occur. These studies are used to show a worst case scenario; other failures may not have such severe results.

1. **Lake Youngs Dam Project:** The Lake Youngs outlet dam is located approximately one mile north of Covington at the head of the Little Soos Creek. The Lake Youngs outlet dam controls 14,770 acre feet of water, which serves as the municipal water supply for the City of Seattle. Dam break scenarios predict failure would likely occur as erosion that would take up to an hour to rise to a maximum discharge volume of as much as 35,000 cubic feet per second. Normal flow is approximately 500 cubic feet per second.

   The dam break flood will first discharge into Little Soos Creek, which feeds into Big Soos Creek. The dam break flood is many times greater than any historic flood on Little Soos Creek. The flow depth and velocity in this creek would be severe and would likely damage or destroy most structures in the flood path. Most road crossings in the flood path can be expected to wash out.

   Thirty minutes after dam break, floodwaters will begin arriving and flow over 172nd Avenue SE where the Little Soos crosses north of SE 240th Street. Depth of floodwaters here may be as deep as 20 feet at full flow.

   Approximately one hour after dam break, floodwaters will arrive at the SE 244th Street and 180th Avenue SE intersection and spill over into Jenkins Creek causing flows larger than any historic flood on the creek. Maximum depths of 10 to 11 feet in this area will be realized. Severe flooding and damage can be expected along Jenkins Creek to its confluence with Big Soos Creek.

   SE 256th street, at the west end of the SR-18 on ramp, SR-516 (Kent Kangley Road) and SR-18 would likely be impassible where Jenkins creek crosses.

   Down stream, food waters will arrive at the Big Soos Creek approximately one hour and thirty minutes after dam break. Floodwaters will peak at 8 feet over the driving surface of Kent Kangley Road and the flows on Little Soos Creek will push floodwaters upstream in the Big Soos Creek to approximately SE 240th Street. Severe flooding can be expected south of Kent Kangley Road with less severe flooding north to SE 240th Street. SR-18 will be impassible where the Big Soos Creek Crosses.

Jenkins Creek will overflow and make Kent Kangley Road impassible in the 18000 block. An isolated island can be expected to form between Jenkins Creek and the Soos Creeks from the overflow of Little Soos Creek at SE 244th Street and 180th Avenue SE at its north, to the point at which both creeks rejoin in the Big Soos Creek south of SR-18 to the south. Since the degree of damage to roads in the area can not be predicted, traffic flow to this island area may not be restored for as long as three days.

Floodwater will continue downstream flowing into the Green River causing severe flooding in the Green River Valley. Downstream flooding will occur in Auburn and possibly as far north as the Tukwila border.

Failure of the Lake Youngs outlet dam may have long term effects on area drinking water supplies.

2. **Tolt River Dam Project:** The South Fork Tolt River Dam is located in the Cascade Mountains, 30 miles due east of Seattle. The Tolt Reservoir can hold over 18 billion gallons of water and its regulating basin can hold over 280 million gallons. The Tolt River Dam produces electricity and drinking water for Seattle and the region. Failure of the Dam may affect Covington's water and electric supply. Inundation maps indicate that major flooding will occur as far east as Snoqualmie Falls, and as far west as Everett.

3. **Cedar Falls Project:** Located 40 miles southeast of Seattle on the west slopes of the Cascade Mountains, the Cedar Falls development is owned by Seattle City light. The project consists of a compacted concrete dam, a gravity dam (Masonry dam), and a tunnel to transport water to a powerhouse two miles downstream. The Cedar Falls Project can hold nearly 16 billion gallons of water. It provides municipal and industrial water storage, supply and hydroelectric power to the City of Seattle and parts of the metropolitan area. An inundation study shows that a flood from the failure of Masonry dam would travel down the Cedar and Snoqualmie Rivers. The flood routing in the Cedar River would affect communities along the River such as Maple Valley and Renton and would finally terminate at Lake Washington. Increased traffic from road closures and shortages of municipal water and electricity may affect Covington.

4. **Howard A. Hanson Dam:** Located on the Green River approximately 35 miles southeast of Seattle, Howard Hanson Dam is operated by the Corps of Engineers for flood control purposes. It is an earth and rock fill structure with a capacity of 106,000 acre-feet and reaches a length of 7 miles. Completed in 1961, Howard A. Hanson Dam prevented over $75 million in flood damages in its first 17 years. During the winter, the reservoir is kept nearly empty. After storms, the tunnel gates control the flow by holding excess water in the reservoir and releasing it in quantities that stay within the capacity of the downstream channel. In the case of an extreme flood, water can be released over the spillway to prevent overflow of the dam, which can cause damage or failure. This has not been required to date. By March, when the probability of flooding diminishes, the dam begins its second function - water conservation. Water is used to augment low flows during the summer season, which ensures a sufficient water level for successful fish migration and spawning.

The area downstream that would be inundated if the dam should fail, with the reservoir at capacity, includes the Green River, Kent, Duwamish, Stuck and Puyallup Valleys. These valleys contain all or portions of the cities of Enumclaw, Sumner, Algona, Pacific, Auburn, Kent, Renton, Seattle, Puyallup and Tacoma. Floodwaters would devastate these valley cities disrupting commerce, traffic and the area economy.

5. **Mud Mountain Dam:** Located on the White River approximately 7 miles southeast of Enumclaw, the Mud Mountain Dam is a rock-fill dam with an earthen core operated by the Army Corps of Engineers. It was built in 1948 for flood control and protects 200,000 people in the lower White and Puyallup River valleys. Estimates show that Mud Mountain Dam prevented $107,596,000 in flood damages between 1948 and 1990. The reservoir has a storage capacity of 106,000 acre feet. When completely filled, the reservoir would reach a length of 5.5 miles and cover 1,200 acres. However, it is usually kept empty except for the normal White River flows.

   Inundation maps show that flooding would occur in the same areas as with a Howard A. Hanson Dam failure with excess flows along the Green, White and Puyallup Rivers.

Conclusion

Failures of the Lake Youngs Outlet Dam will likely result in the loss of life, roadways, structures, property and cause severe impacts to the local economy. While the possibility of failure is remote, the devastating results of such and event cannot be ignored and a plan must be developed and implemented.

Responsibility for the inspection of Lake Youngs Dam rests with the Washington State Department of Ecology.

In the late 1980's the Dam Safety Program of the Department of Ecology was reorganized to better utilize its resources in order to minimize public safety problems. The Dam Safety Section has also recognized the key role of other government agencies in carrying out its public safety charge. For example, the approval process now requires that dams located above populated areas develop emergency action plans in conjunction with the local, county emergency management agency.

A dam break flood inundation analysis for the Lake Youngs Dam was completed for the City of Seattle in April of 2005. A Lake Youngs Planning group was organized mid-year of 2000 to study the issue of public warning and evacuation. The City of Seattle is considering several alert options. For immediate notification to people north of SE 256th Street, a system known as "reverse 911" is being considered. This system will automatically dial all homes in the flood area and issue a recorded emergency message. The Emergency Alert System (EAS) will also likely be a component of notification. Warning and evacuation plans are still under development.

ENERGY SHORTAGES AND UTILITIY OUTAGES

General

Most of King County receives its electricity and gas service from Puget Sound Energy. One exception is Seattle, which receives its electricity from Seattle City Light. Puget Sound Energy is a private company whose electricity services are regulated by the Washington Utilities and Transportation Commission. They are required by law (the Growth Management Act) to supply safe, cost effective and equitable service to everyone in the service area requesting service. Consequently, Puget Sound Energy is Washington state's largest and oldest energy utility, serving nearly 1 million electric customers and more than 650,000 natural gas customers, primarily in the vibrant Puget Sound region.

Puget Sound Energy's electricity infrastructure includes six hydroelectric plants, four coal fired plants and six oil and natural gas fired plants. They also buy and sell electricity via the Northwest Power Pool. Electricity is transmitted via high voltage transmission lines to substations where the voltage is decreased and transferred to distribution lines and eventually to individual hookup lines. Nationally, 99% of all power lines are above ground; most underground lines are used to transmit electricity underwater. These above ground lines are susceptible to high winds and interference from trees and other vegetation.

Puget Sound Energy's natural gas services are quite different. Most of their infrastructure is located underground in the form of pipelines. Puget Sound Energy receives most of its natural gas from Canada via a pipeline that goes from Sumas Washington to New Mexico; although they can purchase natural gas from anyone in the United States.

History

King County has a history of major power outages, typically caused by large storm events. The two most recent events affecting King County were the 1993 Inaugural Day storm and the 1990 Arctic Express. The Inaugural Day storm brought sustained winds of 65 mph and gusts up to 80 mph. Both floating bridges were closed, 50 transmission lines were down, 120 sub stations were damaged, and 450 distribution circuits were down or damaged leaving more than 282,000 King County customers without power. The Arctic Express hit first on December 18, 1990 and then again 10 days later reversing most of the restoration work that had been done. 73,000 customers were without power following this event and damages totaled $17 million.

Utility outages could also be caused by equipment failure or damage. One example being Seattle's Great Blackout of 1988. During this event a construction crew hit an unmarked, buried Seattle City Light electric cable. This caused a short circuit which started a fire at a nearby underground utility vault. Over 50 blocks of downtown were without power for four days. The area incurred significant economic losses as many restaurants and retail shops were unable to open for Labor Day weekend and Seattle City Light spent $730,000 repairing the fire damage.

A seemingly new kind of outage was prevalent during the summer of 1996 when problems with line loading caused major regional power outages along the west coast. Washington State is connected to a regional electrical transmission grid, which has major connections with other grids out of region, including British Columbia, Montana, California, and other southwest states.

In general, even if Washington is short of electricity, due to drought, for example, it can be purchased from elsewhere. The result is higher cost electricity, rather than inadequate supply.

Utility companies build on a N-1 capacity. This means the utility is prepared for one of each kind of line to go down without a disruption to service. If two of the same type of lines goe down, some may lose power. In these recent events, multiple lines were affected and the utilities were unable to compensate or shut down lines quickly enough. During the August 10, 1996 event, Portland was forced to take everything off line to avoid melting of transmission lines from the overload of power.

Vulnerability

Electricity: Because most out of region power is thermal, it is not affected by drought. In fact, a shortage of electricity is not a major concern in Western Washington. This is because a substantial amount of electricity is transmitted from Canada to California via Washington and Oregon, therefore providing easy access to external power supplies. Hot weather and increased use often associated with droughts can be a concern for electric utilities, however. Increased loads cause electric lines to heat up; when lines get too hot they sag. Lines sagging into trees and other vegetation are a major concern and therefore loads must be monitored to control sagging.

The process of deregulation of the electric utilities industry may increase the number of outages, at least in the short run. Deregulation allows many parties to act as buyers and sellers. This makes it difficult to monitor and balance the loads on transmission lines. These types of problems will most likely increase the possibility of regional outages similar to those experienced during the summer of 1996. An article in the Seattle Post Intelligencer recently analogized “In a worst case scenario, that fast paced new market might end up being like a racetrack, where cars occasionally crash and burn. Preventing the electric version of the car crashes, brownouts and blackouts in this new market poses significant technical challenges”.

Growth management is also a constraint, which could possibly lead to outages or shortages. Most new development expects access to electricity but does not want to be in close proximity to sub stations. The political difficulty in sighting these sub stations makes it difficult for the utility to keep up with regional growth.

Natural Gas: The vulnerabilities of the natural gas system is quite different than the electric energy system. Because the natural gas infrastructure is underground, this area is not as susceptible to major gas outages like those associated with electricity. In fact, a natural gas outage of 300 households is an extremely rare event.

This area’s natural gas system is vulnerable to earthquake damage, third party damage and landslide damage. Earthquake damage could include a catastrophic systems failure in which ground movement causes a pipeline to sever allowing gas to escape. Puget Sound Energy is less concerned with gas escaping in wild settings, where life and property are not threatened. This is because natural gas is lighter than air and will quickly dissipate, minimizing risks. Gas escaping into buildings or heavily populated areas is a bigger concern. The current infrastructure does include control valves for shutting down pipelines in the event of such problems. The City of Seattle’s natural gas system is more vulnerable to ground shaking than other parts of King County. This is because Seattle has a low pressure system made of cast iron, which does not do as well in earthquakes. The marina that caught fire after the Loma

Prieta earthquake had this type of system. Puget Sound Energy is in the process of replacing this system with one that handles ground shaking more effectively.

Third party damage is the most common natural gas related problem reported by Puget Sound Energy. This damage typically occurs when contractors dig into gas lines. Puget Sound Energy works closely with local fire departments in responding to these incidents. Additionally, they are training contractors in system design so that they will be more aware of where pipelines are likely to be.

Individual customer systems are vulnerable to flood damage and earthquake damage. Floods can put pilot lights out, which can lead to leaking. Earthquakes can cause water heaters to fall over causing leaking or fires. Puget Sound Energy is attempting to educate the public with regards to water heater safety, encouraging customers to strap down water heaters and consider the option of earthquake protection valves which stop the flow of gas when the earth shakes.

King County is also vulnerable to energy shortages. Natural gas shortages are rare but tend to occur during cold weather. These shortages are a function of infrastructure and demand. During unusually cold weather events the demand for natural gas can exceed the carrying capacity of Puget Sound Energy's pipeline infrastructure. Puget Sound Energy has cold weather policies in place to minimize the effects of these shortages.

Effects

King County is vulnerable to localized, short term energy emergencies brought about by accidents and storms. Most of these emergencies are handled by the affected industry. The effects of energy shortages could include inconvenience to consumers, reduced heating and lighting capability, reduced production in all sectors, potential failure of transportation, water and waste, communication, information and banking systems. Secondary hazards associated with these events could include traffic accidents as traffic lights are out, limited patient care at local hospitals due to power capacities of backup generators, injuries due to downed power lines and fires due to gas leaks.

Conclusion

Government agencies work with the energy industry to ensure effective distribution and emergency response. The Defense Electric Power Administration of the US Department of Energy has the responsibility of working with the electric power industry to ensure maximum generation, transmission, and distribution of electric power to meet essential needs within the state of Washington, as well as other states which depend on common sources of electric power by virtue of interconnections. The US Department of Energy has the responsibility of working with the gas industry to ensure maximum production and for the release of natural gas in transmission systems to meet the most essential needs.

Energy customers, including businesses and home users, need to educate themselves in dealing with energy outages and shortages to ensure safety. Mitigation of risks is paramount. Strapping down water heaters, preparing emergency kits with battery operated radios and flashlights, and learning how to properly shut off utilities are first steps to safely dealing with these events.

FOOD AND WATER CONTAMINATION

General

The food and water supply in the United States is remarkably safe. Nevertheless, food and water can become contaminated with a variety of germs.

The Center for Disease Control estimates that 76 million Americans get sick, more than 300,000 are hospitalized and 5,000 people die from food borne illnesses each year.

Definition of Hazard

Contamination is the act or process of contaminating something or becoming contaminated, or the unclean or impure state that results from this.

Something That Contaminates is something that physically contaminates a substance.

History and Probability of Occurrence in Covington

King County has a history of outbreaks of illness resulting from food supply contamination. However, no extensive outbreaks of illness have been attributed to water supply contamination in recent memory. As with other hazards, it is also important to examine examples from other areas in order to provide insight into what **could** occur here.

Food Supply Contamination:

- January 1993: 500 cases and 3 deaths were attributed to an E-coli outbreak in the Northwest. The source was undercooked contaminated meat.
- August 1993: Nine restaurant patrons in Seattle are infected with the E-coli bacteria.
- Summer 1996: 1,000 people living in 11 different states became sick after being exposed to the microbe cyclospora in contaminated fruit. This was an eye-opening epidemic because “parasites are rarely the cause of large food borne outbreaks”.
- Summer 1996: 9,500 people in Japan became ill from an outbreak of E-coli 0157; hundreds required hospitalization and 11 people lost their lives. The exact source of the contamination is unknown, but radish sprouts or foreign beef were suspected.
- October 1996: Five children were hospitalized after drinking unpasteurized juice contaminated with E-coli.

- November 1996: 125 homeless people suffered from food poisoning after eating at a homeless shelter in Seattle. 45 were treated at area hospitals.

Water Supply Contamination:

- March 1993: An estimated 370,000 people in Milwaukee fell ill in the largest recorded outbreak of a waterborne disease in United States history. High levels of a parasite called cryptosporidiosis entered the public water supply. The Milwaukee Aids Project attributed the deaths of 54 patients to the parasite.
- July 1993: New York City's unfiltered water supply suffered contamination when unhealthy levels of a bacteria believed to be from sea gull droppings was detected. No illnesses were directly attributed to this bacterium.
- Summer 1996: A well serving about 300 residents that live outside Duvall's city limits was scheduled to be shut down for fear of contamination. The well sits within the 100-year flood plain of the Snoqualmie River and there is nothing to protect it from contamination.
- 1993 - 1994: Washington State had the most drinking-water health violations among all the 50 states. One example in King County is Kangley, a rural community east of Kent. They have a permanent boil water order because the unfiltered, unchlorinated, untreated system often tests positive for bacterial contamination.

Potential Impact and Vulnerability

Food and water supply contamination has not been a significant hazard in the United States during the last century. Over the past decade, however, the vulnerability of our nation's food supply and local communities' water supplies has been increasing. Primary reasons for the increased risk include:

- The globalization of the food market has increased travel time between harvest and consumption.

- Parasites, bacteria, and other organisms have become more resistant to pesticides.

It can take up to a week for people to show signs of exposure. This makes it difficult to track the source because people tend to forget what they ate. Additionally, more people can contract the illness during the incubation period.

Another impedance to quick diagnosis is that there are new parasites and bacteria being identified all the time. The cyclospora outbreak occurred just three years after it was first identified as a parasite. This means that doctors can be trying to diagnose an illness they have never learned about. Also, many of the tests for contamination do not attempt to detect these organisms. Some organisms are so potent that only a few microbes are needed to infect, thus, even when attempts are made, the contaminated food source can escape detection.

Certain populations are at increased risk to food and water supply contamination. Those most at risk are populations with weakened immune systems, like the elderly, AIDS patients, and cancer patients receiving chemotherapy. Healthy people can fight off many illnesses in a week to ten days, but if an organism is not checked by the immune system it can quickly become life threatening.

Effects

After eating contaminated food, people can develop anything from a short, mild illness, often mistakenly referred to as "food poisoning", to a life threatening disease.

If the contamination leads to an epidemic, it could severely tax the health care system in regards to diagnosis, treatment and prevention. A community could also be affected by loss of productivity and wages.

Conclusion

Careful food preparation is the primary way to prevent illness associated with food supply contamination. Most parasites and bacteria stay on the surface of fruits and vegetables if the skin is not broken or damaged. Therefore, proper washing of fruits and vegetables close to the time of consumption can decrease the risk of exposure. Proper washing means "removing any contaminants physically in a stream of clean, running drinking water". Meats need to be properly and completely cooked to reduce the risk of E-coli and salmonella. Finally, foods must be properly canned in order to avoid botulism.

Safe drinking water requires two critical steps: protection and treatment. Pollution prevention needs to be integrated with safe drinking water programs. Additionally, proper and frequent testing of water supplies is necessary to avoid future outbreaks. All “Group A” public water systems in Washington state (greater than 15 connections) are required to collect samples for coliform bacteria analysis per WAC 246-290.

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Hazardous Materials Releases

General

King County has one of the highest probabilities in Washington State for being the scene of a significant hazardous materials release. Hazardous materials are transported over or near numerous bodies of waters, wetlands, environmentally sensitive areas and through numerous densely populated centers. They are transported by air, ship, truck and pipeline. This is directly related to the high level of diverse industrial facilities and transportation routes passing through and terminating in our county.

Natural disasters like sever storms, floods and earthquakes might also result in spills. Illegal drug labs and dumping proliferate in the area and present yet another concern. Recent history shows an increase in the threat from terrorist use of hazardous materials. Recent history has also provided several examples of transportation system failure associated with pipeline failures. Both natural gas and petroleum products pipelines have failed in the area. The combination of possible sources of exposure to our sizable population and workforce presents complex problems to responders. It is difficult to find a home, school, hospital or place of business in our modern society that is not vulnerable to the possibility of a hazardous materials release.

King County includes one of the largest deepwater seaports on the west coast. SeaTac Airport handles cargoes from all over the world. Covington is down wind of the port and beneath the flight path for SeaTac and Boeing Field. Local highways that carry hazardous materials to/from/through King County include I-5, I-90, I-405, US Highway 2, State Route (SR) 18, SR 516, SR 167, US Highway 99 and others. Fuel pipelines run through the county from Whatcom County toward Portland carrying jet fuels, diesel, gasoline, etc. These lines have “spurs” going to Harbor Island and SeaTac Airport. During a natural disaster, the number of spills that can be expected from these sources will be much greater than usual.

History

The Washington State Hazard Identification and Vulnerability Analysis cite an average of 960 emergency spills annually in King County. Recent significant events in King County include: the release of 2,500 gallons of fuel from Olympic Pipeline at their Renton pumping station, the release of hydrofluoric and nitric acids from Boeing’s Auburn plant, natural gas transmission line near Auburn caused many cubic feet of gas to be released, numerous drug lab events, metal finishing company fires at Boeing and Universal Manufacturing, a spill at UPS in Redmond, numerous releases of ammonia from cold storage facilities and the release of a small amount of chlorine from a public water company. Response teams have narrowly averted some potentially large releases.

Hazardous materials may also be released during transport. The Washington State Department of Transportation reported that almost 60,000 transportation incidents resulting in the accidental release of hazardous materials occurred between 1987 and 1989. King County has not had any significant railroad incidents in recent years. Covington has the potential with a rail line at the cities south border. The rail line is operated by Burlington Northern & Santa Fe. Pierce County recently had a derailment, which spilled boric acid and diesel fuel into south Puget Sound. The head on collision between two trains in Kelso escaped a major spill. Two recent derailments in

Snohomish County resulted in a fire and evacuation that lasted several days. Rail lines run throughout downtown Seattle and populous areas of King County.

King County also has numerous abandoned hazardous waste sites that are being cleaned up under the Superfund program. There are at least five sites in Kent and one very large site in South Seattle.

Vulnerability

Primarily, spills happen in the course of routine daily commerce anywhere hazardous materials are handled or transported. There are over 3,000 facilities with hazardous materials located in the City of Seattle alone that are regulated under the fire code. Areas with high concentrations of hazardous materials usage include Harbor Island, the Duwamish Corridor, Redmond and the Kent Valley. Business types that commonly use hazardous materials locally include: hospitals, schools, metal plating and finishing, the aircraft industry, public utilities, cold storage companies, the fuel industries, the communication industry, chemical distributors, research and high technology firms. Each of these facilities is required to maintain plans for warning, notification, evacuation and site security under various regulations. The majority of releases that occur during regular commerce happen at fixed facilities.

Harbor Island and western Washington have very large fuel storage areas. The Harbor Island area is vulnerable to earthquake damage and subsequent fuel spills into the Duwamish River and Elliot Bay. These may occur from above ground storage, pipelines or fuel transfers from tankers. Events would produce severe fire hazards and enormous environmental damages to fish, wildlife and commerce.

While the majority of incidents tend to involve petroleum products, a significant number involve extremely hazardous materials. Extremely hazardous materials are those materials, which may do irreversible damage or cause death to people or harm the environment when released or used outside their intended use. Examples are: ammonia, chlorine and sulfuric acid. Approximately 200 local facilities with extremely hazardous materials report their inventories to the county under SARA Title III provisions. Efforts continue to increase the compliance rate and the education level of local facilities. In excess of 300 hazardous materials events require response in King County annually. In addition, many events are not reported or go undetected.

Hazardous materials may also be released as a secondary result of natural disasters like earthquakes and floods. In either case, building or vehicles can release their hazardous materials inventories when they are structurally compromised or are involved in traffic accidents. Pipelines can be exposed or ruptured from collapsed embankments, road washouts, bridge collapses, and fractures in roadways. Nearly every neighborhood in urban King County includes a natural gas pipeline.

The threat from biological or radiological releases currently primarily exists from their infrequent transportation through King County. With the closing of the University of Washington research reactor in 1985, the only radiological sources in use in the county are for medical purposes. The same can be said for biological samples. No record of a release of these biological materials (beyond sewage) could be found in available files.

Effects

Hazardous materials spills might cause the short term or long term evacuation of an affected area. Depending on the nature of the spill and local weather conditions, residences, businesses, hospitals, schools, nursing homes, the Port of Seattle and roadways may be evacuated or closed to traffic until cleanup can be affected. When spills occur as part of an earthquake, this may compound the county's ability to move response resources and resume commerce. A mass casualty incident resulting from a hazardous materials release would seriously impact the county's medical response community.

Conclusion

There are currently sixteen hazardous materials response teams in King County. Eight of these are public fire jurisdictions and eight are operated by the Boeing Company. The hazardous materials teams in King County are supplemented by private response contractors working with the Environmental Protection Agency and a unit of the Washington State Department of Ecology.

An Area Contingency Plan was developed by the State Department of Ecology in cooperation with Federal, State and Local agencies. The purpose of the plan is "to provide orderly implementation of response actions to protect the people and natural resources of the states of Washington, Oregon, and Idaho from the impacts of oil or hazardous substances spills". The plan accounts for potential problems from vessels, offshore facilities, onshore facilities or other sources. The Environmental Protection Agency has responsibility for all spills in inland waters. The United States Coast Guard has responsibility for all spills in coastal waters.

RADIATION HAZARDS

General

There are a number of potential causes of radiation hazards. Radiation can result from an accident at a fixed nuclear facility, which can "include a variety of complexes in which fissionable fuel is stored or used for such functions as electric power generation or testing, and manufacturing fuels and materials". Radiation can also result from a nuclear detonation. "Nuclear detonation is the thermonuclear reaction (fission or fusion) of a supercritical mass of weapons grade nuclear". Finally, radiation hazards can result from accidents at a research or medical facility utilizing radiological materials in their processes.

History

King County has no history of a radiological accident.

Vulnerability

King County is not vulnerable to accidents occurring at fixed nuclear facilities because there are no fixed nuclear facilities within a close proximity to the County. (The University of Washington's research reactor was closed in 1985). However, King County is vulnerable to nuclear detonation that could occur either purposefully (war or terrorism) or accidentally, "resulting in massive damage from heat and blast effects and contamination of the surrounding area by radioisotopes". The threat of use of a nuclear device by a terrorist group has increased since the breakup of the former Soviet Union. The transfer of weapons grade nuclear material from Russian Republics into the black market in recent years, points to the possibility of a weapon falling into the hands of international terrorists.

King County residents are also vulnerable to accidents occurring at a research or medical facility that uses radiological sources. According to the State Department of Health, there are 129 facilities licensed to use radiological sources in King County.

Finally, the potential exists for a nuclear accident on a Trident submarine coming to Port or docked at the Navy's Bangor facility in Kitsap County. The Navy states that there is no hazard and that all information on the subject is classified. However, there is always a remote probability that an accident could occur.

Effects

Casualties in the state from a nuclear strike could number from tens or hundreds of thousands to millions. All essential local services and facilities, such as fire, medical, and law enforcement, would be immobilized, overtaxed, or affected by radioactive fallout, if present. Most communications and other utilities would be disrupted in a nuclear exchange, however the detonation of a single device would probably cause physical damage only to the local area of the blast.

Conclusion

While the threat of a nuclear disaster is relatively low at the present time, as long as thousands of weapons still exist in the world, the threat of use is still there. Because the potential consequences of nuclear hazards are so severe, preparation must be done. The opportunity to reduce the great numbers of potential casualties exists through preparedness measures, including education, information, training, and planning.

TERRORISM

General

Terrorism has been defined by the Federal Bureau of Investigation as “The unlawful use of force or violence against persons or property to intimidate or coerce a government; the civilian population; or any segment of it, in furtherance of political or social objectives”. The devastation which occurred at the World Trade Center in New York and the Alfred Murray building in Oklahoma City points to the need to plan for potential threats within our own communities.

History

The state level Hazard Identification and Vulnerability Analysis claims that the only two terrorist events occurring in Washington state between 1990 and 1994 occurred in Tacoma. Both were bombings that were attributed to a skinhead group. They occurred within three days of each other in July 1993 and caused only property damage.

Each year King County Police receives hundreds of bomb threats and an average of 200 calls about suspicious packages in unincorporated King County alone. Other events that could be classified as terrorist attacks are the recent bombing of a Seattle uniform company and a bombing of the Southwest District Court in Burien in 1995. Additionally, a bomb found at a Boeing plant in 1985 was believed to have been sent by the Unabomber.

To this we add environmental activists that have moved into the terrorist, better known as Eco Terrorists. Serious environmental terrorism started to mount in the late 1980’s as conservationists fought to prevent loggers from cutting ancient trees that provided habitat for the threatened northern spotted owl. Taking pages right out of a 1985 sabotage manual - "ECODEFENSE: A Field Guide to Monkeywrenching" - terrorists damaged dozens of bulldozers and other logging equipment in timber rich Oregon, Washington, Northern California and Montana.

Some of the groups like Earth Liberation Front (ELF) have destroyed buildings at the University of Washington and homes under construction in the Sammamish area. Other groups are Animal Liberation Front (ALF), Earth Night Action Group and People’s Brigade for a Healthy Genetic Future.

Vulnerability

These events, as well as events in other parts of the country and world, give a glimpse as to what could potentially happen here. Non local events include bombings at the World Trade Center in New York, the Alfred Murray Federal Building in Oklahoma City, Olympic Park in Atlanta and the hostage situation in Lima Peru. Additionally, the bomb scare at Seattle’s Westlake Center in July 1996 helped illustrate King County’s potential vulnerability. The greatest number of injuries and casualties would result from the use of a weapon of mass destruction. These include biological and chemical weapons that can affect people living throughout a larger geographic area. The widespread nature of such weapons makes response difficult.

King County is vulnerable due to its geography. This area is easily accessible and perhaps more importantly, it allows easy exit after a terrorist attack. King County's proximity to waterways, interstate highways and the Canadian border increase its vulnerability.

Potential vulnerable sites in King County include: government institutions, dams, water supply sources, power distribution systems, communications terminals, and financial centers. Corporate headquarters of high profile businesses are also vulnerable to terrorist attacks; King County is home to Boeing, Starbuck's, Nordstrom and Microsoft. Random acts of violence such as the detonation of an explosive device in a public area are also within the scope of terrorism.

Potential occurrences could be the result of actions from domestic or international groups. The terrorist actions could be expected to come about as a result of grievances, real or alleged, toward activities of some government entity, or as retaliation for some governmental act. Terrorist "groups" at play today include international and domestic political or religious groups, organized crime, drug cartels, militias, gangs and people acting according to their individual beliefs; and new groups are constantly emerging. Traditionally, small arms and improvised explosive devices have been the weapons of choice for terrorist entities as they are easy to acquire and use. They will probably remain the primary option for the immediate future. Chances are low but growing that weapons of mass destruction, including biological and chemical weapons, could be used by some groups as such agents are cheap to produce and easy to conceal as well as being relatively lethal.

Effects

Due to the variable nature of terrorist attacks, it is difficult to discuss all the possible effects. The effects of an attack at a dam and the resulting flooding would be drastically different from the effects of a bombing similar to that in Oklahoma City. Generally speaking, terrorist attacks can result in mass casualties as well as property damage to buildings or infrastructure.

Conclusion

All such terrorist potentialities remain difficult to predict and difficult to defend against. King County uses an all hazards planning approach for emergency management. This type of planning provides one basic plan for all types of hazards. This is very helpful for disasters such as terrorist attacks, which can potentially take many forms. It's important to remember that the emergency management, fire, and medical services focus of terrorist acts is on consequence management. Law enforcement agencies, on the other hand, are responsible for prevention of terrorism and apprehending terrorists if an event occurs.

TRANSPORTATION

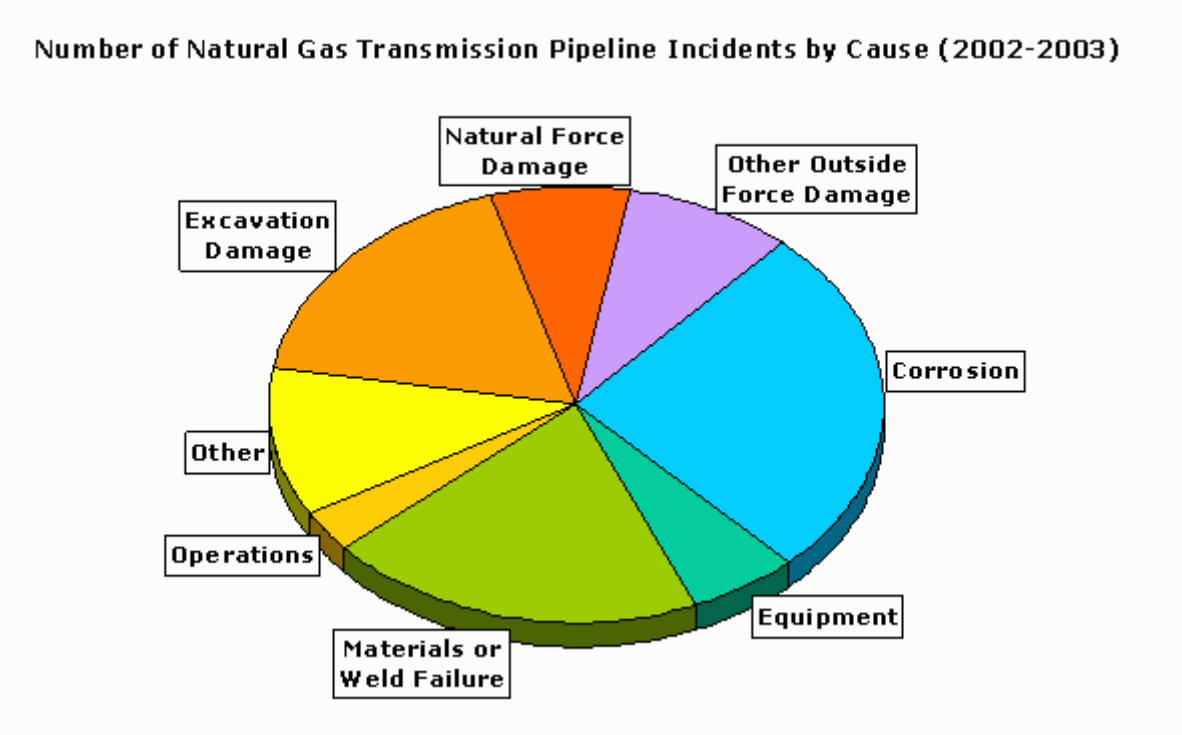
Definition

Transportation, for the purpose of this analysis will be defined as all forms of ground transportation which move people and materials through Covington.

History

While no major transportation disasters have occurred in Covington, traffic accidents are a common occurrence. Likewise, no major disasters have occurred within the City of Covington from the Williams Pipelines that transport hazardous materials (Natural Gas).

US Department of Transportation data.



Natural Gas Distribution Pipeline Incident Summary by Cause 1/1/2002 - 12/31/2003

Reported Cause	Number of Incidents	% of Total Incidents	Property Damages	% of Total Damages	Fatalities	Injuries
Construction/Operation	19	7.8	$2,586,000	5.6	0	16
Corrosion	3	1.2	$60,000	0.1	2	9
Outside Force	155	63.3	$32,934,352	71.4	6	50
Other	68	27.8	$10,517,683	22.8	13	27
Total	245		$46,098,035		21	102

The failure data breakdown by cause may change as Office of Pipeline Safety (OPS) receives supplemental information on accidents.

Note that over 60% of natural gas distribution pipeline incidents were caused by outside force damage in 2002-2003. These incidents can include damage from excavation by the operator or by other parties, as well as damage from natural forces.

Hazard Identification

Privately owned vehicles and local bus services provide the primary means of transportation for individuals in Covington. Increasing traffic congestion within the Covington area has increased the possibility of the occurrence of transportation hazards. Considering that Covington is in a state of growth that will continue into the foreseeable future, this increasing traffic congestion will not level out anytime soon. Covington's main transportation routes are State Route 18, State Route 516, and SE 256th Street. State Route 18 cuts diagonally through Covington from the southwest corner up to the northeast corner. Of the two main east-west routes, State Route 516 (SE 272nd Street) is the most heavily traveled, and SE 256th Street is becoming increasingly well-traveled as an alternate to SR 516.

Vulnerability Analysis

The arterials identified in "Hazard Identification" are the most commonly used of the ground transportation systems within the Covington area. Though there is no accurate figure for the number of vehicles traveling through the area daily, it is clear that traffic is a concern.

Considering the serious traffic problems experienced by both Maple Valley and Kent on each side of Covington, an item of major concern to Covington is the potential for complete gridlock in an emergency situation such as flood, earthquake, hazardous material release or other emergency, requiring an evacuation of homes and businesses in a given area.

Bus traffic is steadily increasing, bringing with it greater possibilities of multiple casualty incidents due to traffic accidents.

While intersections and major highways are particularly susceptible, major accidents can occur at any point along the roadway network. In addition to the obvious injuries and property damage incurred at a major traffic accident, there is great potential for hazardous materials to be involved in such an accident. The involvement of such materials creates additional hazards to both those at the scene and the entire community.

Emergency vehicles and crews could conceivably be badly hampered by traffic congestion. These delays may add to the seriousness of injury and increase the potential for loss of life at accident scenes and other emergency responses. A slowdown in response to any type of an emergency due to traffic congestion is detrimental to life and property within the community.

Burlington Northern & Santa Fe Railroad transportation routes run through and adjacent to the City of Covington. The hazard potential of railroad systems is much like that of highway transportation. Trains, like any other form of transportation are vulnerable to accidents with other vehicles, derailment and acts of terrorism. A potential complication involving rail accidents is the extremely large quantities of hazardous materials transported through Covington on a daily basis.

Likewise, the pipeline, although not contributing to the increase in local traffic, poses a concern through the leakage of a hazardous material from a damaged pipe occurring on its own or from the effects of an earthquake, corrosion and/or third party damage.

Conclusion

The main transportation arterials of Covington, if they have not already reached their full capacity, will be reaching it in the near future and that greatly increases our risk of major transportation emergencies. While no major transportation disasters have occurred in Covington, traffic accidents are a common occurrence. Development of the area has generally decreased the speed of impact of our accidents, but unfortunately has increased their frequency.

Although no incidents have occurred from the transportation of a hazardous material through the pipeline, an occurrence of a leak, from an earthquake or otherwise, would create a hazardous material emergency of a potentially enormous magnitude affecting property, the public and the environment.

AIR TRANSPORTATION CRASHES

Definition of Hazard

The failure of an aircraft to suspend itself in flight due to mechanical or human error resulting in a collision with the ground.

Though there are no airports located within Covington, Crest Air Park is located just south of Covington. The others in closest proximity are SeaTac International, Boeing Field (King County International), Renton Municipal, Auburn Municipal and Cedar Grove Air Park (southeast of Renton).

Both Crest and Cedar Grove Air Parks are used specifically for small private and recreational aircraft. Most commercial air traffic is concentrated at SeaTac International and Boeing Field. Renton Municipal and Auburn Municipal may be utilized as reliever airports by charter and commuter aircraft, however, their primary function is use by private and recreational aircraft.

History of Hazard

Fortunately, the Covington area has not experienced an incident with high loss of life or the devastation possible from the crash of a commercial airliner. However, over the years small aircraft have come down in our area and serve as a reminder of the possibility.

Hazard Identification

Due to the devastating effect on life and property when an air carrier accident occurs, and the frequent news media accounts of what is termed the 'near miss', we are aware that virtually every community is vulnerable to air traffic accidents, including Covington.

Small aircraft traffic is nearly impossible to control or predict, as current regulations and safety equipment requirements are not as strict for small private planes as they are for commercial carriers. Therefore, it cannot logically be concluded as to the probability or the possible location of a small aircraft accident. We do know, however, that several occur each year in the area. We must, therefore, assume that the small aircraft disaster could conceivably happen anytime or anyplace.

Statistics are more readily available on major aircraft accidents, giving a more accurate picture of the potential for disaster and where it may strike. Commercial airline flight paths are alternated on a daily basis to decrease noise exposure to specific neighborhoods. While the exposure of each area to aircraft noise is decreased by this method, this increases the possible areas that could be affected by air transportation crashes.

It is known that 16% of all major airline crashes are low impact crashes on the airport runway. 79% are high impact crashes with few or no survivors and are within one and one half miles of the airport. The remaining 5% crash enroute. In consideration of these facts and the relative proximity of the SeaTac International Airport to the Covington area, we must consider the fact that a major air transportation accident could conceivably happen in our area.

Vulnerability Analysis

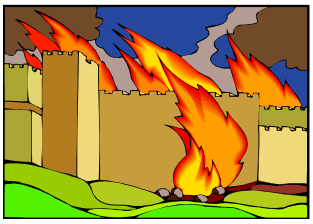
The potential for disaster is great for both the commercial air carrier and the small private plane. Though we may think of an "air disaster" as being the major commercial aircraft crashing and killing over a hundred passengers, we must also consider the small private plane that could crash into a large business, apartment buildings, shopping center or school housing several hundred people. Such an occurrence would quickly exhaust emergency response capabilities and create panic within the community.

The most obvious hazard is, of course, the loss of many lives, both on board the plane and on the ground. Additionally, we must consider property damage from ground impact and the potential fire and explosion hazard associated with up to ten thousand gallons of jet fuel. Aircraft impact with a fixed facility warehousing hazardous substances should also be considered likely, given the prevalence of those types of facilities in the valley area.

Areas in the immediate vicinity and downwind of crash sites may also be vulnerable to the affects of toxic air pollution.

Conclusion

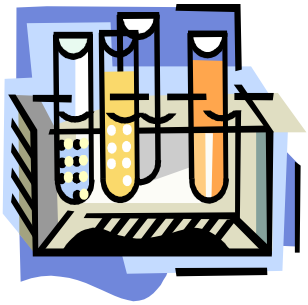
Although a rare possibility, the catastrophic potential of a major aircraft crash in the Covington area cannot be ignored. Tremendous damage to property, utilities and transportation routes could result. Huge financial impact could occur as well as the inevitable heavy loss of life.

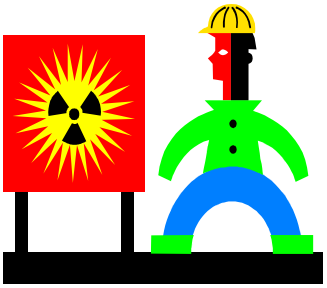


Hazard Matrixes

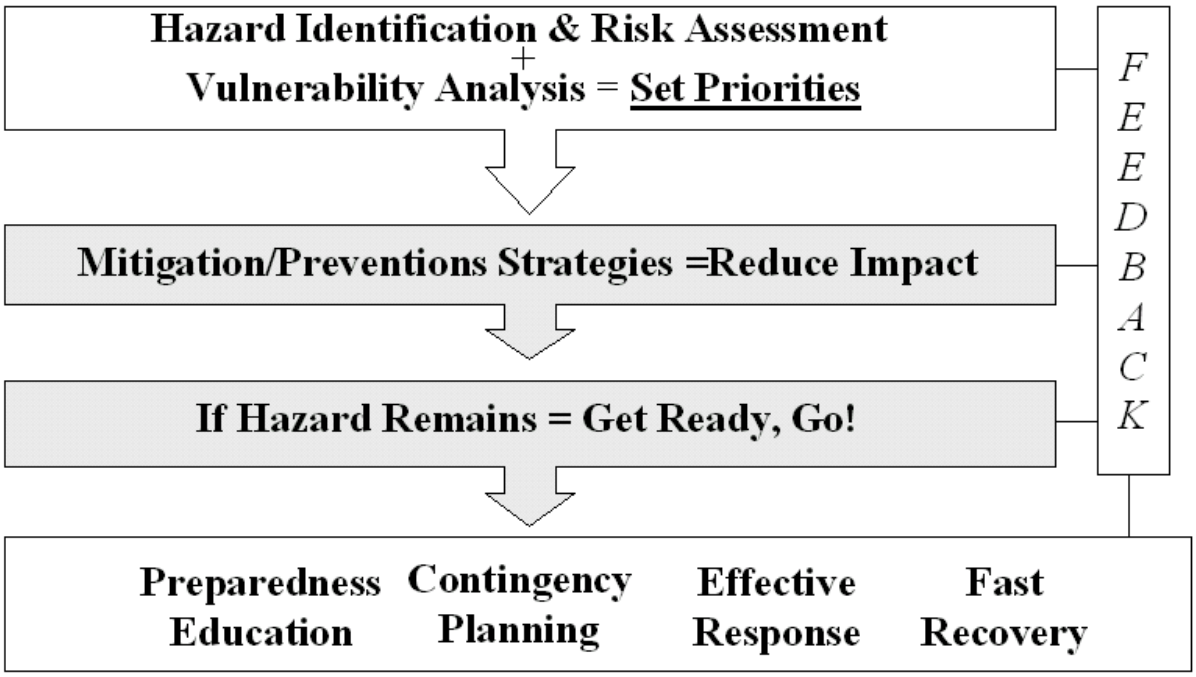
&

Definitions & Acronyms





An Integrated Emergency Management Approach



HAZARD AND EMERGENCY SUPPORT FUNCTION MATRIX INSTRUCTIONS

Purpose

This Matrix is a tool to link hazards that may affect jurisdictions, agencies, and business and the related Emergency Support Functions (ESF). ESF's provide a functional approach to assistance and operational support necessary to mitigate against, prepare for, respond to, and recover from hazards that endanger life, property, and the environment. Across the top are the major hazards that may occur in Washington State. The left column is a listing of ESF's found in the *Washington State Comprehensive Emergency Management Plan* and the *National Response Plan.*

Use

The ESF Matrix is a subjective estimate of what assistance and operational support is necessary to deal with a historical hazard. Marking the intersection of the hazard and ESF(s) with an "x" identifies areas that may require assistance or operational support.

First identify a hazard from the top, or add a hazard if it is unique to your jurisdiction, agency, or business. Then move down and place an "x" in those blocks that indicate the ESF(s) you expect to activate as a result of the hazard. The City of Covington has prepared a Comprehensive Emergency Management P which identified the hazards that are likely to occur within the City and tied them to the corresponding ESF's that apply.

Hazard and Emergency Support Function (ESF) Matrix		Avalanche	Drought	Earthquake	Flood	Landslide	Severe Local Storm	Tsunami	Volcano	Wildland Fire	Abandoned Mine	Chemical	Civil Disturbance	Dam Failure	Hazardous Materials	Local Hazard	Pipeline	Radiological	Terrorism	Transportation	Urban Fire
1	Transportation and Evacuation																				
2	Communications and Warning																				
3	Public Works and Engineering																				
4	Firefighting																				
5	Planning and Analysis																				
6	Mass Care/Shelter																				
7	Resource Management																				
8	Medical, Health and Mortuary Services																				
9	Urban Search and Rescue																				
10	Hazardous Materials																				
11	Food/Water/Donated Goods																				
12	Energy and Utilities																				
13	Terrorism																				
14	Federally Reserved																				
15	Federally Reserved																				
16	Federally Reserved																				
17	Federally Reserved																				
18	Federally Reserved																				
19	Federally Reserved																				
20	Military Support to Civil Authorities																				
21	Recovery and Restoration																				
22	Law Enforcement																				
23	Damage Assessment																				
24	State Reserved																				
25	State Reserved																				
26	State Reserved																				
27	State Reserved																				
28	State Reserved																				
29	State Reserved																				
30	Direction and Control																				
31	Emergency Coordination Center																				
32	Public Information																				
33	Administration and Finance																				

Hazard and Impact Matrix	Avalanche	Drought	Earthquake	Flood	Landslide	Severe Local Storm	Tsunami	Volcano	Wildland Fire	Abandoned Mine	Chemical	Civil Disturbance	Dam Failure	Hazardous Materials	Local Hazard	Pipeline	Radiological	Terrorism	Transportation	Urban Fire
Acid Rain																				
Ash Cloud																				
Communication loss																				
Contamination - air																				
Contamination - ground																				
Contamination - water																				
Evacuation																				
Fire - urban																				
Fire - wildland																				
Flood - urban																				
Flood - rural																				
Fuel																				
Hostage																				
Failure - bridges																				
Failure - buildings																				
Failure - road																				
Landslide																				
Medical emergency																				
Mud/rock flow																				
Riot/looting																				
Sabotage																				
Strikes																				
Transportation - air																				
Transportation - marine																				
Transportation - rail																				
Transportation - road																				
Utilities - electric																				
Utilities - natural gas																				
Utilities - sewer																				
Utilities - telephone																				
Utilities - water																				

WORKSHEET #1: HAZARD IDENTIFICATION AND RISK ASSESSMENT				
Hazard	**Likelihood of Occurrence**	**Location**	**Impacts**	**Hazard Index**
Earthquake				
Landslide				
Flooding				
Wildland Fire				
Hazardous Materials				
Tornado				
Winter Storms				
Wind Storms				

WORKSHEET #2: VULNERABILITY ANALYSIS

Hazard Area Location _____
(Copy the form and complete for each hazard in your community)

	Developed Land			Undeveloped Land		
	Number of People	Number of Buildings	Approximate Value	Number of People	Number of Buildings	Approximate Value
Residential (use max. figures						
Commercial						
Industrial						
Public Buildings and Critical Facilities						
Sewage Treatment Plant						
Water Treatment Plant						
Hospitals						
Schools						
Roads						
Police						
Fire						
Hazardous Facilities						
Total						

WORKSHEET #3: MITIGATION MEASURES			
Policies and Programs	**Document Reference**	**Effectiveness for Mitigation**	**Rationale for Effectiveness**

WORKSHEET #4: MITIGATION PLANNING		
Source	**Existing Goal Statement**	**Effective Goal for Mitigation**
Comprehensive Emergency Management Plan		
Capital Improvement Plan		
Economic Development Plan		
Transportation Plan		
Storm Water Management Plan		
Parks and Open Space		
Other		

WORKSHEET #5: MITIGATION ACTIONS					
Hazard Area Location	**Type of Hazard(s)**	**New Initiative or Recommended Policy Changes**	**Goals Addressed**	**Responsible Party**	**Date Due**

DEFINITIONS

ABANDONED UNDERGROUND MINE - Any large excavation in the earth formerly used to extract ore, coal, or mineral, which is no longer in production.

ACCESS CONTROL POINTS - Road intersections or other logistically viable points on the relocation and food control boundaries which enable law enforcement and other emergency workers to maintain access control of the respective area(s). It involves the deployment of vehicles, barricades, or other measures to deny access to a particular area.

AVALANCHE - A mass of sliding snow, ice, earth, and rock that grows and collects additional material as it descends.

CHEMICAL AGENT (LETHAL) - A chemical substance that is intended for use in military operations to kill, seriously injure, or incapacitate a person through its physiological effects. Excluded from consideration are riot control agents, chemical herbicides, smoke, and flame.

CHEMICAL HAZARD - The release of toxic agents into the atmosphere that can harm population, animals, and food supplies.

CIVIL DISTURBANCE - Any incident that disrupts a community where intervention is required to maintain public safety.

DAM FAILURE - The uncontrolled release of impounded water resulting in downstream flooding, which can affect life and property.

DISASTER - An event expected or unexpected, in which a community's available, pertinent resources are expended; or the need for resources exceeds availability; and in which a community undergoes severe danger; incurring losses so that the social or economic structure of the community is disrupted; and the fulfillment of some or all of the community's essential functions are prevented.

DROUGHT - A condition of climatic dryness that is severe enough to reduce soil moisture and water and snow levels below the minimum necessary for sustaining plant, animal, and economic systems.

EARTHQUAKE - The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth, called a fault.

EMERGENCY - An event, expected or unexpected, involving shortages of time and resources; that places life, property, or the environment, in danger; that requires response beyond routine incident response resources.

EMERGENCY MANAGEMENT or COMPREHENSIVE EMERGENCY MANAGEMENT - The preparation for and the carrying out of all emergency functions, other than functions for which the military forces are primarily responsible, to mitigate, prepare for, respond to, and recover from emergencies and disasters, and to aid victims suffering from injury or damage, resulting from disasters caused by all hazards, whether natural or technological, and to provide support for search and rescue operations for persons and property in distress.

EMERGENCY OPERATIONS CENTER (EOC) - A designated site from which government officials can coordinate emergency operations in support of on-scene responders.

EMERGENCY PLANNING ZONES (EPZs) - The areas for which emergency plans are made to assure that prompt and effective action can be taken to protect the public in the event of a radiological or chemical emergency. In Washington State the first zone is the plume exposure emergency planning zone with an approximate radius of ten miles from the nuclear power plant

or chemical depot. The second zone is the ingestion exposure EPZ with an approximate radius of 50 miles. Immediate Response Zone (IRZ) and Protective Action Zone (PAZ) are zones associated with nuclear and chemical storage facilities.

FAULT - An abrupt shift of rock along a fracture in the earth.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) - Agency created in 1979 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery. Federal Emergency Management Agency manages the President's Disaster Relief Fund and coordinates the disaster assistance activities of all federal agencies in the event of a Presidential Disaster Declaration.

FIXED NUCLEAR FACILITY (FNF) - One of a variety of complexes, in which fissionable fuel is stored or utilized for such functions as electrical power generation, or testing and manufacturing fuels and materials.

FLOOD - An inundation of dry land with water. Types of floods in Washington State are primarily river, surface water, flash, and tidal.

FOREST FIRE - The uncontrolled destruction of forested lands by wildfires caused by natural or human-made events. Wildfires occur primarily in undeveloped areas characterized by forest lands.

HANFORD SITE - A 560 square mile complex, located north of the city of Richland, Washington, under the direction of the U.S. Department of Energy.

HAZARDOUS MATERIALS - Materials, which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, or property when released.

IMMEDIDATE RESPONSE ZONE – The six-mile area surrounding the chemical surrounding the chemical storage area at the Umatilla Chemical Depot.

INGESTION EXPOSURE PATHWAY - When human beings are exposed to radioactive or hazardous materials from a facility through consumption of water and food stuffs, including dairy products. Emergency planning and protective actions are designed in part, to eliminate or reduce to the minimum exposures due to ingestion of contaminated materials in the area surrounding a facility.

LAHAR - Hot rock and gas melts snow and ice, creating surges of water that eroded and mixed with loose rock and debris, also known as a mudflow.

LANDSLIDE - Landslide is the sliding movement of masses of loosened rock and soil down a hillside or slope.

LAVA - Molten rock that flows onto the earth's surface.

LOCAL EMERGENCY PLANNING COMMITTEE (LEPC) - The planning body designated by the Superfund Amendments and Reauthorization Act, Title III legislation as the planning body for preparing local hazardous materials plans.

MAGMA - Molten material beneath or within the earth's crust from which igneous rock is formed.

MAJOR DISASTER - As defined in federal law, is any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other technological or human caused catastrophe in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant major disaster assistance… in alleviating the damage, loss, hardship, or suffering caused thereby.

MARINE SAFETY ZONE (MSZ) – A Chemical Stockpile Emergency Preparedness Program designated 12-mile stretch of the Columbia River.

MITIGATION - Actions taken to eliminate or reduce the degree of long-term risk to human life, property, and the environment from natural and technological hazards. Mitigation assumes our communities are exposed to risks whether or not an emergency occurs. Mitigation measures include, but are not limited to, building codes, disaster insurance, hazard information systems, land use management, hazard analysis, land acquisition, monitoring and inspection, public education, research, relocation, risk mapping, safety codes, statues and ordinances, tax incentives and disincentives, equipment or computer tie downs, and stocking emergency supplies.

PIPELINES - Transportation arteries carrying liquid and gaseous fuels.

PREPAREDNESS - Actions taken in advance of an emergency to develop operational capabilities and facilitate an effective response in the event an emergency occurs. Preparedness measures include, but are not limited to, continuity of government, emergency alert systems, emergency communications, emergency operations centers, emergency operations plans, emergency public information materials, exercise of plans, mutual aid agreements, resource management, training response personnel, and warning systems.

PRESIDENTIAL DECLARATION - Formal declaration by the President that an Emergency or Major Disaster exists, based upon the request for such a declaration by the Governor and with the verification of Federal Emergency Management Agency preliminary damage assessments.

PROTECTIVE ACTION ZONE (PAZ) – An area from the Immediate Response Zone to 20 miles from the Umatilla Chemical Depot.

PYROCLASTIC FLOW - Hot avalanches of lava fragments and gas formed by the collapse of thick lava flows and eruption columns.

RADIOLOGICAL HAZARD - The uncontrolled release of radioactive material that can harm people or damage the environment.

RECOVERY

a. Activity to return vital life support systems to minimum operating standards and long-term activity designed to return life to normal or improved levels, including some form of economic viability. Recovery measures include, but are not limited to, crisis counseling, damage assessment, debris clearance, decontamination, disaster application centers, disaster insurance payments, disaster loans and grants, disaster unemployment assistance, public information, reassessment of emergency plans, reconstruction, temporary housing, and full-scale business resumption.

b. The extrication, packaging, and transport of the body of a person killed in a search and rescue incident.

RESPONSE - Actions taken immediately before, during, or directly after an emergency occurs, to save lives, minimize damage to property and the environment, and enhance the effectiveness of recovery. Response measures include, but are not limited to, emergency plan activation, emergency alert system activation, emergency instructions to the public, emergency medical assistance, staffing the emergency operations center, public official alerting, reception and care, shelter and evacuation, search and rescue, resource mobilization, and warning systems activation.

SEICHE - Standing waves in an enclosed or partially enclosed body of water.

SEVERE STORM - An atmospheric disturbance manifested in strong winds, tornadoes, rain, snow, or other precipitation, and often accompanied by thunder or lightning.

SUBDUCTION ZONE - A convergent boundary between an oceanic plate and a continental plate.

TEPHRA - Clastic volcanic material.

TERRORISM - The unlawful use of force or violence against persons or property to intimidate or coerce a government or civilian population, in furtherance of political or social objectives.

TORNADO - A localized violently destructive windstorm occurring over land and characterized by a long funnel-shaped cloud that extends to the ground.

TSUNAMI - A series of traveling ocean waves of long length generated by earthquakes, volcanic eruptions, and landslides occurring below the ocean floor.

UMATILLA CHEMICAL DEPOT (UMCD) - A United States Army ordnance storage facility located in northeastern Oregon formerly known as Umatilla Depot Activity (UMDA). The Depot has been operated since 1942 as a storage site for conventional Army ammunition, bombs, artillery shells, and landmines. It is now a storage site for unitary and binary chemical weapons and agents.

URBAN FIRE - Urban fire occurs primarily in cities or towns with the potential to rapidly spread to adjoining structures.

VOLCANO - A vent in the earth's crust through which molten rock, rock fragments, gases, and ashes are ejected from the earth's interior.

WILDLAND FIRE - Uncontrolled destruction of forests, brush, field crops and grasslands caused by nature or humans.

ACRONYMS

ARC – American Red Cross

CEMP – Comprehensive Emergency Management Plan

CSEPP – Chemical Stockpile Emergency Preparedness Program

EMD – Washington Military Department, Emergency Management Division

EOC – Emergency Operations Center

EPZ – Emergency Planning Zone

FBI – Federal Bureau of Investigation

FEMA – Federal Emergency Management Agency

FNF – Fixed Nuclear Facility

HIVA – Hazard Identification and Vulnerability Assessment

IRZ – Immediate Response Zone

MSZ – Marine Safety Zone

PAZ – Protective Action Zone

PG&E – Puget Sound Gas and Electric

PZ – Precautionary Zone

ROW – Right of Way

TAR – Tone Alert Radio

UMCD – Umatilla Chemical Depot