Providing Environmental Health Services Following a Catastrophic Event: A Feasibility Study for Rural Health Jurisdictions

by

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A Thesis: Essay of Distinction
Submitted in partial fulfillment
of the requirements for the degree
Master of Environmental Study
The Evergreen State College

June 2009

This Thesis for the Master of Environmental Study Degree

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ABSTRACT

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The Pacific Northwest is prone to large catastrophic earthquakes and tsunamis at least once every millennium. It is important for local health jurisdictions in rural Washington to be prepared to provide environmental health services (i.e. water, food, shelter, sanitation, solid waste, vector control, burials, education) within the first phase of the emergency response. A comparison study was performed between four recent case studies from around the world; Hanshin Earthquake in Kobe, Japan (1995), Asian Ocean Tsunami in coastal Sri Lanka (2004), Hurricane Katrina in New Orleans, Louisiana, United States (2005), and a southwest Washington windstorm in Pacific County, Washington, United States (2007). These studies have proved that it is feasible to provide basic environmental health services in the direct aftermath of a disaster if prior emergency plans have been prepared. The emergency plans need to include collaboration and open communication between agencies and organizations, as well as education and outreach regarding personal preparedness to the local community population. A combination of these basic components in emergency planning will increase the likelihood for a successful response to a catastrophic event.

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ACKNOWLEDGMENTS

I am extremely grateful to all the people who helped me with my thesis. Dr. Laurance Geri, my thesis reader and faculty member of the Masters in Public Administration (MPA) Program for his guidance and continued support and who volunteered to sponsor me when he himself had numerous projects. I would also like to thank Dr. Maria Bastaki, who is a faculty member in the Masters of Environmental Studies (MES) Program who guided me through the initial stages of my project. Dr. Paul Butler, a MES faculty member and Dr. Brian Atwater, a professor at the University of Washington, who piqued my interest in earthquakes and tsunamis in the Pacific Northwest. Steve Brooks, a colleague in the MPA Program who was my co-author in the case study regarding a shelter in Pacific County, Washington. Sarah Pederson, a reference librarian at the Evergreen State College helped me find data and information for my thesis. This paper would also not have been possible without the support I received from Cindy Gleason and Mark Toy from the Washington State Department of Health who provided me with the basic information I needed to start my research, making the entire project possible. I want to express my gratitude to Nancy Morris, Willapa Valley High School English teacher, who was instrumental in reviewing and formatting my paper. The Evergreen State College computer services staff also helped me on numerous occasions with my computer which seemed to have a mind of its own and has done things that only the staff at computer services could understand and fix for me.

I also cannot thank enough the following people for their continued support, partial nagging, and numerous hours brainstorming ideas; the staff (existing and former) at the Pacific County Department of Community Development. This thank you also includes Dr. James Edstam, the Pacific County Health Officer, the Pacific County Health Department, the Pacific County Emergency Management Services, and the Pacific County Prosecuting Attorney's Office. I am also eternally grateful to my husband, Kevin Eldred, my parents, Raymond and Ann Taylor, my brothers, Kyle and Zach Taylor for the many hours they spent reading, correcting, helping me with verbiage, and motivating me to finish the project. I wouldn't have been able to finish it without them.

INTRODUCTION

In the last few years there have been numerous natural catastrophic events around the world from the Great Sumatra-Adaman Earthquake in the Indian Ocean to the events of Hurricane Katrina. The Pacific Northwest is also susceptible to natural disasters -- prone to large powerful earthquakes that strike every 250 to 1000 years with an intensity inconceivable to most people living in the area. It is difficult to estimate when the next one could arrive, but it could be today, tomorrow, next year, or a generation or two from now. Nevertheless, researchers have shown it is inevitable and, therefore, imperative that the emergency response be strategized and prepared.

The preparedness and response plan should incorporate everything from the agencies and organizations involved in the response to their specific responsibilities. These responsibilities will vary and incorporate communication, public and environmental health, infrastructure and rebuilding, and many other services; each of these areas is vital for the community in the short and long term.

Environmental health services are crucial in the first days and throughout the reconstruction phase until the services are permanent. Providing potable water, food, and sanitation are basic necessities for individuals to survive after such an event. It is these essential services that are paramount to rebuilding the community.

LITERATURE REVIEW

Both natural and social researchers have documented the extensive damage earthquakes and tsunamis have had on the Pacific Northwest coast in the last millennium. These large events are deemed to be inevitable and strike with magnitude (M) 8.0 to 9.0 earthquakes roughly every 250-1000 years. The last large earthquake, known as the 1700 Cascadia Earthquake, struck on January 26, 1700, and was documented in Native American folklore, as well as in written records of the resulting tsunami it caused across the Pacific Ocean in Japan. These records identify the impact a large tsunami had on the population along the eastern coast of Japan, due to its devastating effects on the local agriculture and fishing fleets (Atwater, Musumi-Rokkaku et al. 2005). Professor Brian Atwater of the US Geological Survey and Affiliate Professor of the University of Washington in Seattle has researched and studied earthquakes and tsunamis in the Pacific

Northwest for the last few decades and once told me that the likelihood of a substantial event happening in our lifetime may be improbable, but the records indicate that we need to be prepared – just in case.

The World Health Organization suggests that it is imperative that victims be supplied with potable water, food, sanitation, shelter, and vector control as soon as possible after a natural disaster. These basic necessities are the building blocks for living and the quintessential component of good hygiene (Pan American Health Organization 2006). Non-profit organizations, such as the Sphere Project and Oxfam International are humanitarian charters that dedicate themselves to providing environmental health services to victims after large disasters. Providing the basic necessities to survive helps victims through the aftermath of the disaster and stay physically and mentally healthy in the weeks, months, and years of the post disaster phase (Adams 1999; Oxfam GB 2004).

The International Strategy for Disaster Reduction (ISDR) is the agency within the United Nations that facilitates coordination and disaster preparedness around the world and tracks the number of fatalities and survivors in all major events. The ISDR has calculated that a little over five million people have died around the world from geological disasters between 1991 and 2005. In 2004 roughly 92.6% of the fatalities from natural disasters around the world were from geological disasters (i.e. earthquake, tsunami, and/or volcanic event) and 82.9% in 2005. It is possible that these numbers could be reduced with education that provides our individual communities with an improved level of awareness (International Strategy for Disaster Reduction 2006).

The world has seen a multitude of disasters in our recent history with the number of disasters increasing dramatically since the 1960s. (International Strategy for Disaster Reduction 2006). Several large disasters have made an impact on the world population and have given emergency managers new methods of responding to these events. The plans have incorporated new strategies to provide awareness education, and protocols and strategies have been produced in order to provide better response in a time of emergency.

Several case studies of large disasters around the world and one small study on a small event that took place in Pacific County, Washington were chosen to emphasize certain concerns that may be an issue in the Pacific Northwest. These case studies were; the 1995 Hanshin earthquake in Kobe, Japan; the 2004 Asian Ocean Tsunami in Sri Lanka; and the 2005 Hurricane Katrina in New Orleans, Louisiana and one small disaster; the 2007 Windstrom in Pacific County, WA. The earthquake and tsunami represent the field of study of this thesis and the case study of Hurricane Katrina is a

representation of the emergency management infrastructure in the U.S. A smaller case study of a windstorm that took place in Pacific County, Washington in 2007 was used to emphasize the response pattern for a rural jurisdiction.

Sri-Lanka during the Asian Ocean Tsunami was just one country out of many that had mass fatalities and had data available prior to the disaster and post-disaster. The case study of Hurricane Katrina focuses on the City of New Orleans, which is again one small focus when looking at the amount of area that was devastated; however, it shows the emergency response pattern that a large event here in the U.S. has had. The windstorm in Pacific County highlights efforts made by a small rural jurisdiction in providing shelter to the community. With the exception of the windstorm that struck Pacific County, all these disasters were exceptionally large disasters. In each of these cases the specific disasters were not necessarily planned for in these regions except Hurricane Katrina.

The Hanshin Earthquake of 1995 that took place in Kobe, Japan, was a good example of a disaster that happened in a country prone to earthquakes and thought to be reasonably prepared for such an event. However, the lack of preparedness was identified after the event in that the government had not recognized the impact a large earthquake would have on an urban setting. The impact to infrastructure and the lack of governmental response in the first twenty-four hours brought a staggering realization that the 1983 Contemporary Promotion of Urgent Disaster Prevention Countermeasures Act in fact prepared neither the government nor the citizens for such an event (Tierney and Goltz n.d.).

The Asian Ocean Tsunami of 2004 reminded the world that large events can still occur which can impact a number of countries and individuals at the same time. The tsunami struck eleven countries total with the most ravaged countries being Indonesia, Sri Lanka, India, Thailand, and Maldives. Miles of coastline along Sri Lanka were impacted by the tsunami that reached approximately 25 meters in height (Clasen and Smith 2005). Governments around the world stepped up to facilitate aid to the countries in need, yet the local governments were not entirely without resources. The Centre for National Operations in Sri Lanka had in the few years before the tsunami been inundated by flooding and droughts and therefore had put some prevention strategies in place, such as building wells in higher elevation areas away from saltwater intrusion and contaminated flood water (Centre for National Operations 2004). This catastrophe illuminated the need for local awareness regarding such events and the need for local intervention. Many of

the researchers found that the local community members were the ones to provide the much needed aid, be it water, food, clothing, shelter, or the search for victims and the burial of bodies. It was the surrounding communities that provided the most support to the victims (Yamada, Gunatilake et al. 2006).

When Hurricane Katrina of 2005 struck the southeast coast of the U.S., the hurricane devastated the coastal region and eventually lead to the flooding of the City of New Orleans causing over 20,000 people to seek shelter in one locale within the city, the Superdome. The media tracked the storm as it sped across the Caribbean and then struck Florida and eventually the states of Alabama, Mississippi, and Louisiana; the media continued to monitor the situation as the levees in New Orleans started to break. The world watched as tens of thousands of people were stranded in a temporary shelter that was never meant to shelter for more than a few hours. Communication at all levels of government broke down and basic environmental health necessities were non-existent or difficult to come by in the first few days before individuals were evacuated out of the city. Excreta disposal was taking place in open hallways once the toilets backed up. Food and water had to be scrounged up from meal to meal by the FEMA workers in the area (2005).

The windstorm that pummeled Pacific County in 2007 was a surprise, as well as an educational experience for those in the community and in emergency management. The windstorm resulted in total isolation for the county residents, which included a loss of communication and contact with the outside world due road closures from tree debris. This led the county emergency management team to provide shelters for the residents. The shelter was an exercise in planning and coordination with local and federal government emergency management employees and non-profit groups (Brooks and Taylor-Eldred 2008).

The question we need to ask is: is it feasible to provide basic environmental health services in the first two weeks (phase I) after a catastrophic earthquake/tsunami to residents in rural coastal Washington? Environmental health services entail food, water, shelter, sanitation, and other basic needs that are documented in the literature as being important after such a disaster. It is these basic necessitates that will provide individuals with stability and ensure that the community stays healthy both physically and mentally to sustain themselves throughout the reconstruction phase and beyond.

METHODOLOGIES

The overall focus of the project was to provide research concerning the susceptibility of an earthquake happening in the Pacific Northwest and to research the feasibility of providing environmental health services. A comparison was made between a number of case studies of large natural disasters that have occurred around the world in the last two decades and how non-profit organizations and government agencies have provided environmental health services. The heart of the entire study was to gather information regarding the feasibility of obtaining environmental health services in the direct aftermath of a large natural disaster and using the comparison case studies specifically to look at the existing emergency management plans that were in place prior to the disaster and what actually took place on the ground. This specific information was collected through researching journal articles and internet sources from all areas of emergency management, such as government, non-profit organizations, and academia. In many cases, original data was used by utilizing personal recollections that could be found in journal articles, blogs, and diaries on the internet.

This compilation of information is to be used as a model to strategize a response plan for a rural county on the coast of the Pacific Northwest. This information will help emergency management personnel, as well as environmental health staff to respond to such an event.

FINDINGS

EARTHQUAKES

The Pacific Northwest has been identified as a region that is prone to tsunamis and earthquakes, especially large magnitude 8.0 and 9.0 Richter scale earthquakes. On a geological timescale these events occur frequently, but one may not happen in our lifetime despite their unpredictability. Nevertheless we need to be prepared, because it is not a question of whether this might happen, but a question of when.

Geography of Washington

The Pacific Northwest is considered geographically isolated from most of the rest of the U.S. and contains less than 3% of the U.S. population (U.S. Department State 2006). Washington State itself is divided in half by the Cascade Range, which runs from north to south between Canada and central Oregon. The Columbia Plateau lies to the east of the Cascade Range and has a relatively dry climate compared to the west side of the Cascade Mountains. The west side of the Cascade Mountains, commonly referred to as the Pacific Northwest, has a relatively high precipitation of about 150 inches (381 cm) per year. This level of precipitation on the west side has led to much greener and much more forested areas than the eastern side of the state. The Cascade Mountains and the Olympic Mountains sandwich in the Puget Trough, which makes up the Puget Sound lowlands and some of the most densely populated areas in Washington State. Southwest of the Olympic Mountain Range lie two of the largest bays on the west coast, Grays Harbor and Willapa Bays (Pearson Education n.d.).

Figure 1: Pacific Northwest

Source: (Washington Cooperative Fish and Wildlife Research Unit 1991)

Population Density

Population density changes drastically from one area to another in Washington State. The 2000 U.S. Census estimated the population in Washington State to be roughly six million people (U.S. Census Bureau 2000). Currently, more than 60% of the population lives within 60 miles of Interstate-5, which runs from north to south from Canada to Oregon and lies on the west side of the Cascade Range (Go Northwest 2008).

Approximately, 60% of the population lives within the Puget Trough between the Cascade Range and the Olympic Mountains. The coastal counties only make up about 182,000 people (U.S. Census Bureau 2000).

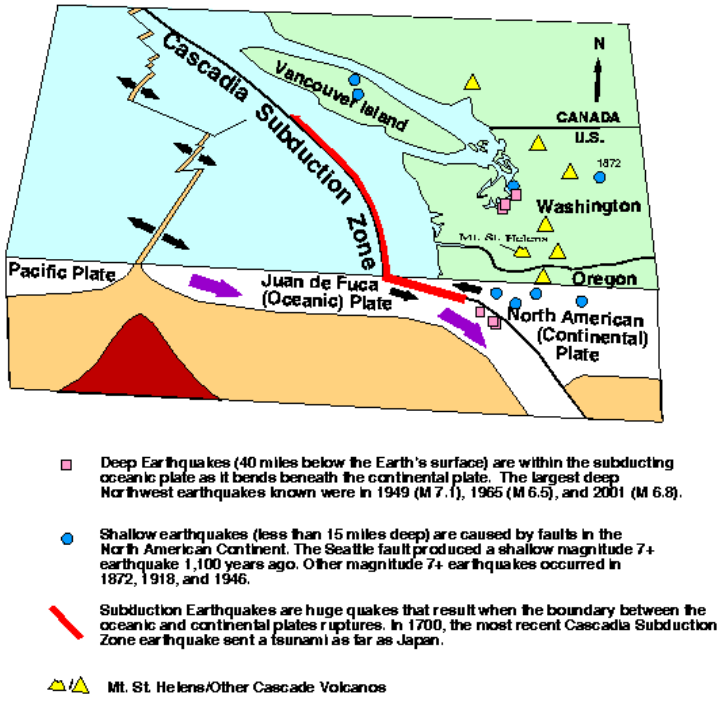
Subduction Zone & Earthquakes

The Juan de Fuca Plate stretches from mid-Vancouver Island to Northern California (Pacific Northwest Seismic Network 2002). The Juan de Fuca Plate is slowly being pushed by upwelling lava which causes it to submerge under the North American Plate, causing energy to build up.

The point where the two plates meet is called the Cascadia Subduction Zone (Pacific Northwest Seismic Network 2002). At some point, this energy will exceed the amount the Cascadia Subduction Zone can contain, and will eventually rupture. Subduction zones cause some of the largest earthquakes in the world, such as the magnitude (M) 8 to 9 Richter scale earthquakes here in the Northwest. Currently, the Juan de Fuca Plate is moving an estimated 4 centimeters per year (Pacific Northwest Seismic Network 2002; Cascadia Region Earthquake Workgroup 2005).

The Richter scale measures the intensity of an earthquake. The scale is logarithmic, and therefore the earthquake intensifies by ten fold for each whole number. Small micro-earthquakes of M 2.0 happen frequently and are usually not felt by humans. Larger earthquakes such as the M 8.0 earthquake in Alaska in 1964 damaged

Figure 2: Cascadia Subduction Zone



Source: PNSN, 2007

roads, bridges, buildings, and led to severe infrastructure damage, especially in the urban areas (United States Geological Survey 2008)

Researchers have been studying the Cascadia Subduction Zone for the last 30 years and have concluded that earthquakes have occurred repeatedly anywhere from 250 to 1,000 years apart with an average of 500 years between them (Cascadia Region Earthquake Workgroup 2005). This evidence has been collected from sand sheets, which are remnants of tsunamis that left a thin sheet of sand between the layers of mud in coastal areas, as well as organic layers found after the land suddenly subsides (Atwater, Musumi-Rokkaku et al. 2005).

Sunken shorelines are an indication of subsidence associated with subduction-zone earthquakes, as seen in Figure 3 of Copalis Beach, WA. Ghost forests are explained by the sudden subsidence of land, which leads to tree roots being inundated with salt water. Tree ring data indicates that the trees did not die slowly from salt-water poisoning, which would be indicative of a slow, drawn-out sea level rise. Instead, the data indicates

Figure 3: Ghost Forest in Copalis Beach, WA

Source: (Clapp 2006)

that the trees were healthy right up to the time of death, and, therefore, this phenomenon happened very suddenly and could have occurred only through the sudden subsidence of the land (Atwater, Musumi-Rokkaku et al. 2005)

The last large earthquake occurred on January 26, 1700, at around 9 p.m.; known as the 1700 Cascadia Earthquake, it is thought to have been between a M 8.7 and M 9.2. This earthquake caused a tsunami, which has since then been named the Orphan Tsunami (Atwater, Musumi-Rokkaku et al. 2005).

This earthquake is also thought to be included in Native American folklore. On January 12, 1864, James Swan visited the Makah tribe and transcribed some of the oral history that he heard during his trip from the Makah leader, Billy Balch. The story goes "that the water receded and left Neah Bay dry for four days and became very warm. It then rose again without any swell or waves and submerged the whole of the cape…"

(pg.12) (Atwater, Musumi-Rokkaku et al. 2005). This story is evidence that a tsunami may have swept through the area with great intensity.

Researchers in Japan have also found evidence of the Orphan Tsunami in records dating from the early part of 1700, when the tsunami struck the east coast of Japan. Records written during that time by samurai, merchants, and peasants that lived along the coastal areas have been discovered which document the fact that the tsunami drove people to higher ground, damaged fishing shacks, drowned rice fields, and caused fires within some of the villages. These documents have been compiled in a 17,000 page document titled "Shinshu Nihon Jishin Shiryo", an earthquake anthology of Japan (Atwater, Musumi-Rokkaku et al. 2005).

Tsunamis

Each type of earthquake (i.e. strike-slip faults or dip-slip earthquakes, such as occurs at a subduction zone) has a unique wave length when the energy is released. Strike-slip earthquakes tend to take place on a vertical plane where the rock slips past one another in the fault on a horizontal plane. A dip-slip earthquake happens when the rock either rises up or drops down. A large subduction zone will release its energy in long-period waves, whereas shallow earthquakes, the kind seen most often in the Pacific Northwest, will release a shorter wave length. Engineers and scientists have studied this phenomenon and have found that a subduction zone earthquake will actually affect taller buildings and longer bridges more than a shallower earthquake (Cascadia Region Earthquake Workgroup 2005).

In many areas along the Pacific Northwest coastlines, the soils are made up of silt and sand or a combination of both. These soils will be susceptible to what is known as liquefaction. Liquefaction occurs when the soils become saturated with water and lose their solidity during an earthquake. Liquefaction can cause buildings, bridges, pipelines, and roads to collapse (Cascadia Region Earthquake Workgroup 2005).

Figure 4: Liquifaction

Source: (Brennan 2007)

A tsunami occurs only with certain types of earthquakes, and its intensity depends on several factors. For instance, a strike/slip earthquake is probably not going to cause a tsunami, but a subduction zone earthquake has a high probability of generating a large tsunami. This is due to the fact that if water is covering a strike/slip fault, not much of the water will actually be displaced. However, a subduction zone earthquake has the likelihood of displacing a great amount of water because as the rock dips into the subduction zone, it displaces the water and therefore creates a wave. (Oregon Emergency Management 2005). It is estimated that a subduction zone tsunami could travel at speeds of 600 miles per hour and arrive at the coastal shoreline within minutes of the earthquake (Earth and Resources 2005). Most tsunami waves are typically estimated to be around 10 meters (30 feet) high (Cascadia Region Earthquake Workgroup 2005). However, a University of Rhode Island ocean engineering professor, Stephan Grilli, has estimated that in some cases the waves could reach up to 20 meters (60 feet) (Island 2002). In general, most emergency managers are working under the assumption that the tsunami will be about 10 meters (30 feet) maximum. In many cases, it is not the earthquake that is deadly, but the tsunami that strikes later (Oregon Emergency Management 2005).

Infrastructure

Researchers and emergency managers alike have identified three areas that will potentially impact infrastructure in the western Washington region. The areas that will see the most damage from earthquake and/or tsunami will be along the coast line. The next will be the I-5 corridor, and then the area east of the Cascades.

The earthquake/tsunami will have different effects depending on the time of day. Individuals commuting during the day on the roads and bridges will be impacted. However, an evening and/or night event would most definitely impact individuals while they are at home sleeping and therefore would potentially be hazardous for those living in structures not designed to withstand such events.

Coastal Areas

Most researchers and emergency managers agree that the coastline will be hit with the most intensity. Bridges, roads, and buildings will be destroyed, and small communities along the coast will have to survive on their own for some time before emergency relief can reach them (Cascadia Region Earthquake Workgroup 2005).

It is estimated that it might be weeks before some isolated coastal communities will actually receive aid. There may be limited medical services depending on where the hospitals are located and the number of roads and bridges to the medical facilities that have been destroyed. Liquefaction will occur in many areas along the coast, especially where buildings have been erected upon sand and silt -- still other areas that are further inland will be affected, especially those areas that are built upon pilings due to weak soils (Cascadia Region Earthquake Workgroup 2005). Liquefaction will occur in any area where the ground is of certain composition, and those areas are found predominantly on the coast, but also in some inland areas.

Pacific County

Pacific County will be used as an example of a rural coastal county that will be severely affected by the aftermath of an earthquake or tsunami.

Pacific County is situated on the southwest corner of Washington State and lies between the Columbia River (south) and Grays Harbor County (north). The county covers 975 square miles and is home to approximately 21,000 people (Pacific County Government Website 2003). The county features a 28-mile peninsula that runs from north to south between the Pacific Ocean and the Willapa Bay (Nation Master n.d.). The peninsula itself is approximately one to two miles wide, and about half the population of the county lives on the Long Beach peninsula. All of the incorporated cities are within a few miles of the Pacific Ocean or the Willapa Bay. The inland areas are very rural and are made up of agricultural farms and forested areas.

Figure 5: Pacific County

Source: (USGW Archives 2009)

The more densely populated areas of the county are located near the coast and many individuals lie within the frequently flooded areas or tidelands. Several cities in the county have been built on pilings. Historically cities were built along the waterways and

have been flooded periodically since their origin. Many of the structures have been placed on pilings to avoid such flooding, but during a tsunami these are all at risk.

I-5 Corridor

Individuals living along the I-5 corridor may be a bit safer than those living along the coast, but the impact to buildings and infrastructure is still likely. Those buildings that remain standing after an earthquake may need to be abandoned due to structural damage or lack of electricity, phones, or water. Roads, bridges, and airports may be out of operation depending on their locale and the type of soil they are built on. Most of the old brick buildings that are along the I-5 corridor may not withstand a large earthquake (Cascadia Region Earthquake Workgroup 2005).

East of Cascades

The residents living on the eastern side of the Cascades may only feel a slight tremor of the earth compared to the several minute long tremor on the west side. Utilities and transportation may be out for some time, but the damage will not likely be as heavy as on the west side. The greatest impact will be to the economy. Without roads, bridges, ports, and airports, goods will not be transported (Cascadia Region Earthquake Workgroup 2005).

Long-term Recovery

The economic impact to Washington State will be devastating. Coastal communities will need to be rebuilt (i.e. buildings, airports, ports, bridges, roads) -- everything will need to be rebuilt from the ground up with the assistance from state and federal agencies. Small towns may become a hub of activity if their airports, ports, and roads are still open to receive necessary goods and services (Cascadia Region Earthquake Workgroup 2005).

Casualties will be an on-going public health issue, and buildings will need to be condemned by community development inspectors due to structural damage (Cascadia Region Earthquake Workgroup 2005). Planners will need to work at re-zoning areas that were devastated by the earthquake and tsunami and start planning for the rebuilding phase (Hwang, Francis et al. 2005).

Just-in-Time

The Cascadia Regional Earthquake Workgroup (CREW) is concerned about the availability of supplies in time of need. Just-in-Time (JIT) inventory is important for our economy here in Washington State. JIT encompasses the idea that stores do not carry more than a day or two of inventory, which helps cut down on the storage space, thereby saving money. Most citizens will have to rely upon stores to supply them with materials and food to restart their lives after a major earthquake. This might be impossible if roads and bridges are impassible for trucks to deliver goods. Also, most warehouses and distribution companies are within the Kent and Duwamish Valley, and these large buildings are sitting on soils that will be susceptible to liquefaction. The fact that stores rely on JIT inventory is a major problem. It is not necessarily just stores that will be impacted, but also hospitals for public health needs (Cascadia Region Earthquake Workgroup 2005).

Those communities that manage the best will be those that have been working on mitigation processes and know what type of resources are available around them (Waugh and Streib 2006).

Susceptibility

The evidence is hard to ignore; researchers and professionals have all accepted the fact that earthquakes and tsunamis are part of our history and will be part of the future here in the Pacific Northwest. As is the case in Pacific County, a majority of the population in coastal communities live near the water. It is this very environment that will create havoc in the case of a disaster, such as an earthquake or tsunami.

Now that the evidence is clear, it is important for those of us living in coastal areas to start preparing for the inevitable earthquake/tsunami to happen. How well are we prepared for this type of catastrophe?

RESPONDERS

In a time of emergency, the public depends on the government to provide the necessary services that are needed to survive and re-build their lives. These services might include anything from medical services, to food and water, to infrastructure such as road construction and building. Lives are dependent on these services being offered to

the public. So, who is required to respond following major disasters? And who is responsible for what services? The Department of Homeland Security states in the National Response Framework that "effective response hinges upon well-trained leaders and responders who have invested in response preparedness, developed engaged partnerships, and are able to achieve shared objectives" (pg 2) (Homeland Security 2008). The primary objective for emergency response is to save lives, protect property, and protect the environment.

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) is the primary contact for the federal government when there is a national emergency. The Federal Emergency Response Plan (Public Law 93-228) was enacted in order to provide federal assistance to those areas that have been declared a disaster by the President. The Plan is the key to understanding the change of command during an emergency and an essential component when coordinating with federal, state, and local entities (Yeats 1998).

When a disaster is declared by the President, FEMA is prepared to respond and be deployed immediately to the area. This deployment always consists of a disaster field officer, who manages the FEMA activities. These activities range from rescue to the distribution of financial aid for residents and businesses. FEMA is also theoretically in charge of managing all other federal agencies that respond to such activities, as well as large non-profit organizations, such as the Red Cross. The team of FEMA members oversees many areas: "transportation, communications, public works/engineering, firefighting, information planning, mass care, resource support, health/medical services, urban search and rescue, hazardous materials, food, and energy" (pg. 236) (Yeats 1998).

Roles & Responsibilities

Ultimately, the local government is the first to respond to incidents and has the responsibility for the public health and well being of its communities. The role of the state government is to effectively support the local government in response to a disaster. In the case when a governor of a state feels that the state's resources have been overextended then the governor can request the emergency assistance from the federal government to assist in supporting the efforts taking place at the local level (Homeland Security 2008).

Elected and Appointed Officials

Elected or appointed officials, be they county commissioners, county managers, or mayors are responsible for the health and welfare of their communities and should have a clear understanding of their roles and responsibilities in such an event. All jurisdictions should have some type of emergency management officer who works on a daily basis updating and identifying policy and protocol in regards to emergency management affairs (Homeland Security 2008).

Department Heads

Department managers are to assist the emergency manager with the planning. The variety of departments brings a diverse mix of information and resources that can be used in the planning process (Homeland Security 2008).

Invariably the response is a coordinated effort between local law enforcement, emergency management, hospitals, public health, environmental health, mental health, communication, pubic works, and other organizations (Lien n.d.). All these responders have their individual responsibilities. The only organization that is given the responsibility of providing the communities with potable water and food are those in the environmental health services. Many people assume that public and environmental health are presented with the same duties; however, public health nurses tend to the sickly, whereas the environmental health professionals are trained to look at what is causing the illnesses.

Personal Preparedness

Individuals need to be prepared in case of an emergency. To rely on an organization or the government to step in and rescue individuals and households in the first few days to weeks following a disaster is impractical. It is important that individuals take the responsibility for their own care and be prepared in numerous ways for the eventual disaster, in everything from their basic necessities to homeowners' insurance. Many individuals think they can rely on the federal government for all their needs. However, the government has only limited resources. The typical person should have at least three days' supply of food, water, medicine, and other supplies that may be needed (Homeland Security 2008). However, many rural jurisdictions are asking individuals to have at least a seven days supply of necessary supplies (Department of Health 2008).

Homeowners insurance is also an important point that people need to think about. Only 10% of the populations that live in earthquake prone areas in the United States have earthquake insurance. The non-profit organization, the United Policyholders, insists that people should not look to the federal government to bail them out in a time of need. The FEMA has very little funds available to help individuals rebuild their lives and homes. The U.S. Small Business Administration has small loans for homeowners and businesses; however, the loans are very small and have to eventually be repaid (United Policyholders 2008; U.S. Small Business Administration n.d.).

Successful Response Efforts

The key points in the National Framework for response efforts are engaged partnership, tiered response, scalable, flexible, and adaptable operational capabilities, unity of effort through unified command, and readiness to act. The federal response plan describes these five points that are needed in order to successfully respond to a disaster (Homeland Security 2008).

Engaged Partnership

Engaging partners prior to a disaster is vital to the success of a response. These partners may include federal, state, local governments, as well as non-profit organizations (NGOs), businesses, and private citizens. It is important that partners be included within a small local jurisdiction but that some cross training with partners across jurisdictional boundaries also takes place (Homeland Security 2008).

Tiered Response

That National Framework stipulates that a disaster be managed at the lowest jurisdictional level possible, which in most cases means the local jurisdiction that the disaster has occurred in. The local jurisdiction has the responsibility to manage the disaster, and the federal government expects that response to start and end at the local jurisdictional level (Homeland Security 2008).

Operational Capabilities

The agencies and organizations that are responding to an event are required to adapt to the surrounding requirements needed at any given time. This entails being

flexible and adaptable from the initial stages of response to the last stages of recovery (Homeland Security 2008).

Unity of Effort

In gaining partnerships and working towards a common goal of effective response the partnerships must understand the hierarchy of the command structure and each agency's and organization's responsibility. This will effectively connect the partners within the jurisdiction and from outside the jurisdiction. All response teams need to be familiar with the Incident Command System (ICS). This system can successfully integrate agencies and organizations that may have or have not partnered with one another in the past to communicate and work efficiently with one another as a team (Homeland Security 2008).

Readiness to Act

Communication is the key in acting swiftly and successfully when responding to a situation. It is important that the structure of the organizations that are responding allow for growth when necessary. Incidents may in some cases need to grow if the onset of information confirming the situation is more dire than previously thought (Homeland Security 2008).

Organizations

The type of emergency responders and organizations will vary from region to region depending on the population density and the amount of destruction. Some will be the traditional firefighters and ambulance personnel and others will be from non-profit organizations, such as Red Cross volunteers and local public and environmental health officials. In the more rural areas it will be neighborhood volunteers, since no other responders will be able to travel to the rural locations. Therefore, the number and type of responders will vary. It is up to these individuals to be prepared; however, the general public needs to take some responsibility and be prepared themselves.

It is the responsibility of all emergency responders to be prepared in case of a disaster. They are accountable during an emergency to the community members that need shelter, food, and water. This is an enormous responsibility that many of citizens in the northwest have yet to comprehend.

Planning

Careful planning leads to better levels of preparedness for all involved. The National Framework follows a simple cycle of planning, organizing/training/equipping, exercise, and evaluation, which then leads once again to planning. This simple framework is a key to getting a strategy in place for whatever disaster may occur (Homeland Security 2008).

The planning phase should encompass the entire disaster from the very initial strategic moves to the very last planning steps in the reconstruction stage. This planning process should incorporate the key points to a successful response: the engagement, tiered response, operational capabilities, unity of effort, and readiness to act. These logistical moves should not necessarily be an exact-to-the point plan, but all-encompassing plan, which can evolve and flow in many different directions (Homeland Security 2008).

Organizing and preparing for the possibility that the plan may need to be put into action and to practice different scenarios in which the plan could possibly be used is essential. Presumably during these exercises, areas that may need training and equipment will be identified, therefore making a more effective response the next time the situation arises (Homeland Security 2008).

Once the scenario has been organized and exercised, then typically an evaluation of the scenario will be written up, and once again emergency managers and fellow colleagues will return to the drawing board to re-evaluate the plan and to incorporate points that may have been lacking (Homeland Security 2008).

Local government is primarily responsible for their own communities and are not to expect and rely on the federal and state governments to step in and protect them during a disaster.

However, the truly important key point is that all individuals and families take responsibility for themselves. It is uncertain whether infrastructure will still exist after a large earthquake or tsunami, and therefore, the accessibility for emergency response teams to reach all communities is doubtful. Thus, individuals and communities need to prepare for the eventuality that they will need to rely on themselves and their communities. This need for individual preparedness was put to the test by the Hanshin Earthquake.

HANSHIN EARTHQUAKE – Kobe, Japan

The Hanshin Earthquake struck Hyogo Prefecture at 5:46 a.m. on January 17, 1995. The earthquake registered as a M 6.8 on the Richter scale. The earthquake struck the southern area of the prefecture; most the casualties were in the surrounding area of Kobe. A total of 6,398 people died that day as a result of the earthquake, and 90% of those deaths were due to collapsed buildings; the rest were due to fires that broke out after the earthquake. Roughly 40,073 people were injured in the quake, and 446,474 homes were completely destroyed. The earthquake caused infrastructure to break down and roughly 1.3 million people were without water and 2.6 million were out of electricity (Shrestha 2001; Kobe 2008; Tierney and Goltz n.d.).

Figure 6: Neighborhood in Kobe, Japan

Source: (Friberg 2008)

Emergency Plan

In 1961, Japan enacted the Disaster Countermeasures Basic Act, which was to research and provide disaster prevention, reinforce the systems in place for emergency response, design and construct projects to facilitate against disasters, and improve the communication and information regarding emergency disasters. Then in 1983 the Contemporary Promotion of Urgent Disaster Prevention Countermeasures was enacted, which was to create mechanisms for prediction and to emphasize the necessity of earthquake preparedness. (Shrestha 2001)

A Central Disaster Prevention Council (CDPC) exists at the national level and each local jurisdiction has a Local Disaster Prevention Council (LDPC) (Ministry of Foreign Affairs of Japan n.d.). At the time of the Hanshin disaster in 1995 these councils were in place; however, these systems were considered ineffective by the media and public after the quake due to the fact the local jurisdiction did not realize the extent of the damage until much later, because of the lack of communication and the large number of government employees that were unable to make it to work; therefore, the LDPC could

not respond effectively with the much needed resources. All lines of communication were disrupted, including radio, telephone, faxes, etc. The power failure wasn't necessarily due to downed lines, which was the case in some areas, but the overuse of the telephone lines of family members and friends calling one another. The phone use rose fifty times that over any other normal day (Shrestha 2001). Also, inter-organizational preparedness was lacking. Many of the individual organizations were well prepared; however, the concept of multi-faceted organizations working together on a single goal was not something that had been prepared prior to the disaster, and those agencies that had prepared for such a response were unable to communicate due to the lines of communication being down. The fact that many of the government officials were victims themselves compounded the problem; only about 20% of government employees were available to help in the initial response. The first employee to arrive at work arrived one hour after the disaster struck and only 5 out of the 21 employees that were required to be at the first Emergency Headquarters Meeting were able to make it. (Shrestha 2001; Tierney and Goltz n.d.).

Figure 7: Roads in Kobe, Japan

Source: (Uchida n.d.)

Since Kobe, Japan is very urban, there were hundreds of thousands of people needing food, shelter, and water, yet prior to the Hansin Earthquake the Japanese government had not established a distribution system for basic necessities. As Kathleen Tierney and James Goltz note in their research article titled "Emergency Response: Lessons Learned from the Kobe Earthquake", any emergency response plan that has been put in place would have been taxed to the breaking point due to the large earthquake in an urban setting, the number of casualties, and the number of people in need (Tierney and Goltz n.d.).

The last major earthquake that had struck the Kobe area was in the 1940s, and therefore the theory that emergency managers are inclined to plan for the most recent threats and not those that are so infrequent that they may not happen in their lifetimes was proved true. The plans that had been set in place prior to the earthquake were for much

smaller earthquakes, and therefore the plans had to be changed midstream to handle the serious need for shelter, food, emergency supplies, and the disruption of transportation. In 1991, a survey instigated by the Prime Minister's office found that only 8.4% of the population in the Kansai area were prepared for a large earthquake (Shrestha 2001; Tierney and Goltz n.d.).

Response

The Self Defense Force (SDF) was supposedly called four hours after the earthquake; however, they were not activated until the next day, 24 hours after the event. The blame for the slow response has been directed to both the Kobe officials, but also the SDF in their slow response. However, even other cases have pointed out that it was no one's particular fault, but the event itself was such a catastrophe that some time was needed to plan, organize, and implement the first response (Shrestha 2001; Tierney and Goltz n.d.).

Those victims looking for shelter found themselves in schools and parks; however, these locations were not able to accommodate the many hundreds of thousands of people needing shelter and emergency supplies. The government agencies and non-profit volunteer groups found it difficult to provide the necessary water, food, toilets, and emergency supplies that the victims needed in a first few hours to days after the event took place. The earthquake struck in January; therefore the victims needed shelter and blankets quickly due to cold outside temperatures. Taking care of the elderly and handicapped posed more difficulties than expected and treating the victims' injuries was difficult due to the issues of transportation and road closures.

According to a *New York Times* article by Nicholas District dated January 28, 1995, the victims had little food or water for the first day or two after the earthquake (Kristof 1995). Documented recollections in English from residents are scarce; however, a foreign exchange student from Ghana by the name of Charles F. A. Akayuli documented his recollections. He arrived at Kobe University in Japan on December 20th, 1994, less than a month before the Hanshin Earthquake. His memories of that morning are of being woken up and running outside, where he sat shivering in freezing temperatures while hanging out in the local playground until daybreak when the damage could be accessed. Once daybreak came it was realized there was no water or gas; however, they still had electricity and many people crowded around the one television they could find to hear the news. They had no food and just a small amount of water that

they shared among themselves, which consisted of the fellow students in the dormitory. By the end of the second day water tankers could be found at certain locations if one was willing to wait. Water was only available for drinking and flushing toilets. Food was provided by individuals living in and around the area. By the second week the SDF installed a public bath for hygiene promotion, where baths could be taken every other day, and water containers were placed in areas that were easily accessible (Akayuli 1995). Others individuals such as Kazuko Okuda, a professor emeritus of Konan Women's University in Kobe, remembers she only had two slices of bread the first two days following the earthquake, and it wasn't until the third day she had her first warm food, which was a cup of coffee (Kyodo n.d.).

Between January 20 and 24, an estimated 236,899 people required shelter in 599 shelters. Emergency management associations such as fire fighters and paramedics had a difficult time dealing with the aftermath due to lack of infrastructure, and therefore volunteer groups and community members spontaneously emerged and offered their services and supplies to those in need (Tierney and Goltz n.d.).

Japanese are well known for their loyalty and volunteerism to their schools, work, and communities; however, the outpouring of volunteerism to strangers is out of the ordinary. As a result, the outpouring of volunteerism during this event was surprising. Roughly 630,000 to 1.3 million people volunteered, overwhelming the emergency response system the government had felt they had in place. The governmental response to the earthquake was condemned as ineffective. Japan is known for their public awareness regarding earthquakes and the preparedness levels, and therefore to be ineffective was a shocking realization that the response system might not be adequate for the size of the catastrophe.

ASIAN OCEAN TSUNAMI – Sri Lanka

The Indian Ocean Tsunami, otherwise called the Great Sumatra-Adaman Earthquake, took place on the morning of December 26, 2004, 100 km (60 miles) off the coast of Sumatra, Indonesia, and was documented as a magnitude 9.0 earthquake. Approximately two-thirds of Sri Lanka's coastline was hit by the tsunami, causing destruction and roughly 38,195 deaths, and almost a million people became homeless with 70% of the fishing vessels destroyed. The tsunami was traveling at speeds up to 800

km/hr (500 mi/hr) and struck Sri Lanka almost 2.0-2.5 hours after the earthquake (Marshall 2005; Yamada, Gunatilake et al. 2006; Gracin, Desprats et al. 2008).

Emergency Plan

The Sri Lankan government had no legal framework for disaster management plans set in place prior to 2005. However, after the 2004 tsunami the government enacted the Sri Lanka Disaster Management Act, No. 13 of 2005, giving the National Council for Disaster Management (NCDM) and the Disaster Management Centre (DMC), legal authority to plan and prepare for natural disasters (2005).

In the years preceding the tsunami, the Sri Lankan government did have a number of agencies without any legal authority to go into disaster stricken areas after an event had taken place and to give aid. The Democratic Socialist Republic of Sri Lanka has been working with the Sri Lankan Department of Ministry of Disaster Management and Human Rights and the Centre for National Operations before the 2004 tsunami. In 2003, there were floods that displaced citizens and the government constructed tube wells in order to provide drinking water to those displaced individuals. Also, modern water tanks and rainwater tanks were installed in areas stricken with drought. However, the government's goal was to provide aid after a disaster and not necessarily to provide prevention and preparedness strategies (Centre for National Operations 2004).

Response

The response to the tsunami from other counties was overwhelming. By the second day the president of Sri Lanka had declared a state of emergency, and within three hours of the declaration, the Japanese, Indian, and Pakistani governments had sent relief groups in to help with the devastation. However, most-on-the-ground reports indicate that the local response saved more lives and aided most of the survivors before any international aid arrived. This quick response by the local communities saved more lives than the Sri Lankan government or international aid did (Current Affairs - Sri Lanka 2005; Overington 2006).

The Sri Lankan government was faced with an enormous task of having to respond to such a catastrophic disaster when they had very little experience dealing with such matters. In ordinary circumstances the Sri Lankan military oversees all emergency response; however, the military had no system set in place to communicate with other

agencies and organizations, such as the incident command system (ICS) here in the United States. Therefore there was no way to communicate between the military and other organizations nor was there any type of command structure. Within the first 24 hours the president declared a state of emergency and established a Centre for National Operations (CNO). This organization was to organize and manage the international and national relief efforts. It took two more days to have the CNO fully functional and operating (Yamada, Gunatilake et al. 2006).

The initial response (phase I) was made by a few thousand civilian community members who brought food, clothing, and shelter within the first and second day after the disaster struck. These local citizens were able to begin volunteering before the government was able to organize and activate their emergency response (Yamada, Gunatilake et al. 2006). Shelters were provided at temples, churches, and mosques and the volunteer citizen groups assisted in searching for those missing and managing those that were dead, transporting individuals to emergency services; still others collected and managed the donations and relief aid that came in from the neighboring villages and communities (Yamada, Gunatilake et al. 2006). Once the international aid organizations arrived, they brought basic food necessities and tablets to provide potable water. Yet, there were complaints from the victims that once they arrived they indeed had food and water, but when warnings were made by the governments that there could be more tsunamis in the near future the organizations pulled out of those areas and left the victims with no food or water (Record staff and news services 2004).

Over 60,000 wells were inundated with water; however, in the 24-48 hours after the disaster, the victims were able to obtain water from groundwater sources that had not been contaminated with seawater. (Ballantyne 2005) These groundwater sources lacked the capability to produce the large quantities needed for the victims, and very few people had containers to store the water. Soon after aid appeared from the government and other aid organizations, it was found that the distribution of packaged water in polybags (200 mL) and in plastic tanks (500-2500 mL) was the best way to distribute potable water. The problem with these plastic items was the fact they contributed to the growing solid waste issues that the shelters and camps were facing. In some areas mobile water treatment purification and desalinization plants were activated, but only on a limited basis. In other areas some organizations had individuals treating their own water by boiling, adding bleach or chlorine tablets (Clasen and Smith 2005).

The tanker trucks, which in turn filled the large plastic storage tanks, were the most efficient way to provide the victims with potable water, yet there was a inconsistency and misunderstanding of who was responsible for decontaminating the water and making sure that the water had been treated correctly. In some cases it was the Public Works Department, which would make sure the victims had the quantity of water to survive, but the Health Boards would be in charge of the quality of water depending on the communities, which made it confusing. In most cases there was no identified body to ensure that citizens were getting good quality water, and in some cases the fecal coliform counts exceeded the guidelines set forth by the World Health Organization (WHO). Though, in retrospect, the guidelines documented by a number of emergency health organizations emphasize that the quantity is more important than the quality; therefore, these organizations may have been looking to fulfill the quantity that was required rather than the quality. Nevertheless, there were also reports of tanker operators having refilled their trucks not from the bored well points, but from irrigation canals and other contaminated sites to meet their daily quota for the distribution of water. The victims were also seen filling up their storage containers by dipping them into the tankers trucks rather than using the hose outlets, which would further contaminate the tanker trucks (Clasen and Smith 2005).

In addition, the healthcare system was overwhelmed; all hospitals located near the coastal communities were overtaxed with victims needing medical help. The solution was to transport victims to other hospitals that were not located within the tsunami zone; however, most roads were inaccessible due to the debris from the aftermath of the tsunami. The victims were able to be transported via helicopters once the military arrived (Yamada, Gunatilake et al. 2006).

The mass fatalities made circumstances particularly difficult due to the fact most hospital morgues were only equipped to take 5-10 bodies at a time. In most cases when someone died outside of the hospital, a judicial medical officer at the hospital was to determine the death of the individual, but in this case the hospitals were overrun and many of the smaller medical facilities did not have medical staff on hand. Those people on the ground recall some of the hospitals being so overwhelmed with fatalities that the doctors and medical staff had to leave the premises. The medical staff at the hospitals tried to identify the bodies as the bodies were brought in by taking pictures and fingerprinting them; however, as the bodies kept coming in and inundating the resources on hand, as well as decomposing at a rapid rate because of being submerged in water for

some time, the staff gave up and bodies were buried in mass graves, not giving the individual or family a traditional burial (Yamada, Gunatilake et al. 2006).

HURRICANE KATRINA – New Orleans, Louisiana

Hurricane Katrina struck Florida late on August 27th and proceeded on to the Alabama, Mississippi, and Louisiana coastlines on August 29th. The National Oceanic and Atmospheric Administration stated the winds were reported to be approximately 119 mph at the Pascagoula Mississippi Civil Defense, and the New Orleans Lakefront reported winds between 69 and 86 mph. It wasn't necessarily the high winds that devastated the southeastern coastline, but the storm surges that accompanied the strong winds. The surges were approximately 10-15 feet along the Alabama coast, 24-28 feet along the Mississippi coast, and from 10-19 feet along the Louisiana coastline (Graumann, Houston et al. 2005).

In southeast Louisiana the city of New Orleans sits below sea level; the storm surge caused the level of Lake Pontchartrain to rise, causing the levees that protect New Orleans to collapse and the system to eventually fail. The water started to pour in on August 30th and ultimately covered 80% of the city in depths anywhere from a minor few inches up to 20 feet (Graumann, Houston et al. 2005).

The United States Government Accountability Office estimates that there were roughly 1600 deaths and that it affected more than a half million people along the southeastern coastline of the Alabama, Mississippi, and Louisiana spanning approximately 90,000 square miles (Government Accountability Office 2008).

The hurricane caused more than 1100 fatalities in the state of Louisiana with one-third of those fatalities due to the public and environmental health circumstances after the floods in the shelters and hospitals (Jonkman, Maaskant et al. 2009).

Emergency Plan

Southeast Louisiana and the City of New Orleans contracted with the United States Department of Homeland Security/Federal Emergency Management Agency (FEMA) in June of 2004 to spend roughly a half million dollars to create a catastrophic hurricane disaster plan. The emergency management consultant Innovative Emergency Management (IEM), Inc. was to create a functional exercise and to develop a response and recovery plan. The plan was to consider the area's location and elevation in relation

to the ocean, as well as the rapid response that would be needed in such an event (Insurance Journal 2004). The FEMA presented a news release in July, 2004, which indicated an exercise was developed by the National Weather Service, the US Army Corps of Engineers, the LSU Hurricane Center, and other state and federal agencies. The exercise was held over five days and concluded that a number of areas needed to be focused on, such as debris cleanup, sheltering, search and rescue, medical, and schools (Federal Emergency Management Agency 2004).

In August, 2004, IEM, Inc. submitted a draft document of the Southeast Louisiana Catastrophic Hurricane Functional Plan, which identifies the logistical response panes, areas of concern, and responsibilities. The plan states in many of the cases, the local governments are not in charge or responsible, but the federal government. FEMA is identified as being the "central point of contact" in case of a Category III or greater hurricane, where there has been massive damage and water and ice needs to be distributed to the victims (pg 17) (Innovative Emergency Mangaement 2004).

Response

With 80% of New Orleans flooded, sanitation, food, and potable water were scarce. In a Congressional Hearing on October 20, 2005, Mr. Marty Bahamonde, an employee with the Federal Emergency Management Agency testified before the House Select Committee regarding the response to Katrina. Mr. Bahamonde, a public affairs officer, was the only FEMA employee in New Orleans before, during, and after the hurricane struck. On August 26th, he was asked by FEMA headquarters to position himself in New Orleans from the Emergency Operations Center (EOC) in New Orleans, which is where he sent a multitude of documents concerning the storm to the headquarters via e-mail, phone calls, and pictures.

Mr. Bahamonde was able to provide the headquarters with information regarding the Superdome, which became a shelter for thousands of people before the storm because of the traffic jams and difficulty for some individuals to get out of the area. The superdome continued to be a shelter after the storm for thousands of people and Mr. Bahamonde was able to observe the superdome from his location at the EOC, which was directly across the street from the Superdome. The shelter had a scarcity of basic necessities such as sanitation, food, and water. On August 31st, he wrote an e-mail to the Director of FEMA, Mr. Michael Brown, that the situation was "past critical" because the shelter was out of food and water and the flood waters had finally reached the Superdome.

On September 3rd, Mr. Bahamonde wrote an e-mail to fellow FEMA colleagues in which he acknowledged their hard work and dedication to the situation but that the senior officials were not prepared for this type of event and therefore not in touch with the reality of the situation. FEMA stepped in to help on August 30th, two days after he had communicated with headquarters regarding the help with individuals in the Superdome shelter (2005).

On August 28th, as the Superdome became a shelter out of necessity the individuals at the EOC scrambled to find toilet paper in all the city buildings for those individuals in the shelter. Mr. Bahamonde overheard the request from the city's Homeland Security Director and realized the situation in the Superdome was worse than he had thought. Mr. Bahamonde continued to monitor the situation by sending pictures and information back to headquarters regarding the shelter before the storm ever hit. On Sunday night, the night the hurricane struck, he waited in anticipation for the FEMA Disaster Medical Assistance Team from Houston, as well as the National Guard. The Guard were supposed to be bringing 360,000 ready-to-eat-meals (MRE), in addition to 15 trucks of water; however as the storm began to strengthen, only 40,000 MREs were provided and 5 trucks of water. The medical teams that were expected never showed.

Mr. Bahamonde heard the news on August 29th at 11 a.m. that the levees had broken and that it was "very bad", which he quickly sent on to headquarters. That day he spent the day gathering information and relaying the information to headquarters. By Tuesday, the 30th, the Superdome was surrounded with water chest deep and the Superdome was out of food and water. Mr. Bahamonde remembers that the stench of the Superdome from the lack of sanitation was unforgettable. The FEMA medical team arrived on Tuesday and they, with the National Guard and Coast Guard, spent the next few days looking for food and water for the individuals stuck in the Superdome. Each individual had approximately two meals a day (2005).

Mr. Bahamonde stated that the Superdome became a "cesspool of human waste and filth". Approximately 25,000 people were confined to the area for five days with no toilet facilities. The hallways and corridors were used as toilets and "trash was everywhere". By Thursday, the 1st of September, the individuals began being evacuated from the Superdome. However, because of a riot that was supposedly being orchestrated, the FEMA employees were required to leave immediately for their safety. At this point Mr. Bahamonde said he requested that they all stay due to the grave nature of leaving all

these people without food or water, but his requests were denied, and therefore he left (2005).

Mr. Bahamonde expressly stated in the hearing that he believed that there "was a systematic failure at all levels of government to fully comprehend the magnitude and the severity of the situation" (2005).

On September 2, 2005, five days after Hurricane Katrina made landfall in southeast Louisiana, ABC World News Tonight noted that the residents of New Orleans continued to search for food, water, and clothing (Yassin 2005). By September 1st there were a number of companies that had started to provide potable water to the residents through bottled water or tanker trucks. Most of these companies did not reach the area until the 5th; however these companies trucked all the way from Texas, Georgia, and Nevada to the victims of the storm for days afterwards (WaterWorld n.d.). Some companies, such as American Water Star Incorporated, started production on the 30th of August providing 125 truckloads of water per day, seven days per week (Buisness Wire, 2005 #7). Organizations such as the Portable Sanitation Association International (PSAI) coordinated efforts to bring portable toilets to the New Orleans area and other devastated areas. They had as many as 50 trucks at one time carrying portable toilets for the individuals sheltered and working in the area (Brzozowski n.d.).

Since that time, response contingency plans for New Orleans have changed in that they will not use the Superdome as a shelter in future emergencies but will make sure that all citizens that would like to leave the city will be able to do so by buses or trains and that the Superdome will only be used as a staging area from this point on. The residents of New Orleans will also be required to evacuate in the event of a category 3 hurricane and will receive their notice via text messages on their cell phones (Natonal Public Radio 2007; MSNBC 2009).

SW WASHINGTON WINDSTORM – Pacific County, Washington

. On December 2, 2007, two large storm systems blew into the southwest region of Washington State. High levels of precipitation and hurricane force winds, which were clocked up to 141 mph in Pacific County, ultimately led to structural damage, road closures, power outages, flooding, and a loss of communication with the outside world (Brooks and Taylor-Eldred 2008).

On Friday, November 20, 2007 the National Weather Service (NWS) warned that significant storms containing high winds and rainfall levels were predicted. A series of storms containing hurricane force winds exceeding 100 mph and reaching 141 mph struck southwestern Washington (Brooks and Taylor-Eldred 2008).

In Pacific County, the largest impacts stemmed from high winds that caused massive tree fall and extensive damage to homes and businesses. All access roads in and out of the county were blocked in multiple locations, electricity was cut off from thousands of customers, and there was no way to communicate with individuals outside the county. (Brooks and Taylor-Eldred 2008)

Emergency Plan

The officials of Pacific County have long recognized their potential vulnerabilities during significant weather events, such as the relative isolation of a small county. Following the NWS predictions on November 30th, the county's Office of Emergency Management sent out an email to predetermined officials and residents notifying them of the impending storms. Such notifications are not uncommon in the coastal county and most officials report taking normal preparedness measures such as securing doors and windows on facilities. No one, however, was expecting the type of storm that struck the county two days later (Brooks and Taylor-Eldred 2008).

The county emergency response plan includes contacting officials and residents listed on the distribution list that the Pacific County Emergency Operations Center (EOC) has created, as well as preparing the EOC in case the center needs to be activated. The plan assumes that residents have at least a three day supply of food and basic necessities and possibly up to seven days or more (Brooks and Taylor-Eldred 2008).

Response

The EOC tried opening on Monday morning, December 3, 2007; however, due to road closures from blown down trees and debris the center was not able to open until late Monday afternoon. Once the EOC was open, it became the nerve center from the short-term response planning, long-term recovery strategies, and provided briefings to policy makers(Brooks and Taylor-Eldred 2008).

Providing food and shelter for county residents became one of many priorities for officials as they staffed the EOC. Discussions were held regarding when and where it would be appropriate to open a shelter and how it would be equipped and managed.

Administrators from the South Bend School District stepped forward to offer their facility as a potential sheltering site. While there was approximately $400,000 in storm damages to the school, the building's cafeteria remained intact. A consensus was reached that this was an appropriate location for a shelter. Following this decision, county officials began investigating where supplies and staffing for a shelter could be obtained. The key element that was missing at the school was electricity to operate the kitchen and lighting. The National Guard was activated by the Governor, Christine Gregoire and reported having four to five generators available for deployment to Pacific County. The main obstacle to this plan was the continued closure of all access roads into the county created by the fallen trees. The first paths through the debris were actually created by citizens and loggers anxious to get back to their homes to check on family and friends(Brooks and Taylor-Eldred 2008).

It took until late in the evening on Tuesday, December 4th before the National Guard generators could reach the South Bend School. Once they arrived, school officials and volunteers were disappointed to learn that some of the units were in poor operating condition (some even missing critical parts) and had little to no set-up and operating instructions. It was also quickly evident that connecting the generators to the school's electrical system would be a major undertaking. A dedicated group of local electricians reports to the school and worked 12 hours making the necessary alterations to the school and to get as many of the generators as possible to operate. Finally around noon on Wednesday, December 5th the lights were on and the kitchen was operational (Brooks and Taylor-Eldred 2008).

With the electricity issues were being addressed, county officials were in contact with the Red Cross regarding staffing and supplies for the sheltering effort. Red Cross volunteers from the local community were on-site early in the discussion and set-up phases of the operation. Outside support and supplies were deployed to the area and arrived on Wednesday morning. This group brought enough cots and other supplies to accommodate approximately 80 overnight guests at the shelter. This team met and coordinated with South Bend School officials. Several dedicated food service staff members from the school, assisted by community volunteers, worked around the clock to prep the facility and cook the food (Brooks and Taylor-Eldred 2008).

For those in the community without adequate disaster provisions, it was well over 48 hours since their last opportunity for a meal. The shelter was able to open its doors and serve hot food by 1 p.m. on Wednesday. It is estimated that roughly 1,000

meals were served by the shelter. Between four and six hundred people actually ate at the shelter and the remaining meals were taken out to other families and community members. Only about five to six individuals utilized the shelter's overnight sleeping facilities. Local officials attributed this to the mild weather that was brought in with the storms. Had the outages been more sustained or the weather more inclement then it is believed that the number of individuals utilizing the shelter would have grown substantially (Brooks and Taylor-Eldred 2008).

Since, the December 2007 storm, the county emergency management officials have been working non-stop to prepare for the next emergency by identifying shelters and pre-determining the basic necessities that will be needed in each case. The emergency management team has also been busy creating a longer distribution list, which will notify community members of the incoming storm (Brooks and Taylor-Eldred 2008).

The officials have cited communication as a major challenge -- both land lines and wireless. Residents felt isolated and largely uninformed about the ongoing response and recovery and were unsure where to go to receive accurate information. Facilities, such as the South Bend School District were not designed to operate on generators and therefore establishing generator power was the single greatest struggle sited by the sheltering effort (Brooks and Taylor-Eldred 2008).

PROVIDING ENVIRONMENTAL HEALTH SERVICES

The following section of the report will suggest specific techniques for managing and providing environmental health services for the public during a catastrophic disaster. The services include drinking water, sanitation, solid waste, shelter, vector control, and other necessary services creating the basic foundation of public and environmental health.

Drinking Water

Potable drinking water is essential to the survival and health of victims during an emergency event and continues to be important through the days, weeks, months, and years after such an event. Many of the diseases seen in survivor camps are excreta related; therefore, it is vital that each individual has a sufficient amount of clean water for drinking and washing themselves -- particularly their hands. Clean water can help

provide the barrier that is needed against infectious diseases by allowing people to maintain good hygiene and sanitation (Adams 1999). The World Health Organization Guidelines for Drinking Water states that "every effort should be made to achieve a drinking-water quality as safe as practicable" (USGW Archives). Providing an ample amount of potable water for individuals could mean the difference between life and death for the victims of natural disasters (Adams 1999).

Initial Assessment

John Adams, in his book, Managing Water Supply and Sanitation in Emergencies, states that a "good initial assessment is one of the keys to a successful emergency water supply"(pg. 30). During the planning process it is essential to make certain that the number of people in an area (i.e. camp, town, or city) will not exceed the supply of potable water available. A sufficient amount of space is necessary between the water treatment facilities, watering points, latrines, and solid waste facilities to prevent cross-contamination. In some cases, temporary camps and shelters may become long-term settlements. Therefore it is necessary to plan proactively. It is imperative that water can effectively be carried or pumped to all areas of a settlement or community without being cost prohibitive. Sources of water, which may include springs, streams, lakes, etc., must be evaluated for their abilities to sustain the appropriate numbers of people (Adams 1999).

Quantity

The amount of water needed for a single person varies depending on the culture and location of a community. However, Davis & Lamber, in their book titled Engineering in Emergencies: A practical guide for relief workers, writes that at least 5 lcd (liters per capita per day) is needed for individuals during an emergency and the quantity needs to be increased to 15 lcd as soon as it is feasible to do so. (Davis and Lambert 2002). John Adams, author of Managing Water Supply and Sanitation in Emergencies states that "If there are choices to be made about increasing water quantity or improving water quality when time and resources are scarce, priority should always be given to increasing the quantity of water available, even if the water provided is contaminated" (pg. 111). In extreme circumstances during an emergency event and for very short periods of time, water has been supplied to individuals contaminated with up 100 fecal coliforms per 100 milliliters. Once treatment facilities are in place it is imperative that this poor quality of water is no longer distributed to individuals (Adams 1999).

Initially, each family should have storage containers to store at least 40 liters per day. After the initial phases of a disaster event, 20-40 liters of water per person is usually satisfactory for sustainable living. It gives individuals enough water to consume and to clean themselves. The containers to carry the water from the watering point to the point of consumption should be no more than 20 liters for convenience, and the containers should be made of a durable substance, such as plastic or metal. The containers will last longer if they are durable and are easier to sanitize (Cahill 2003). These containers should have narrow necks or lids to keep the water from becoming contaminated (Oxfam GB 2004).

Quality

Drinking water should follow the general World Health Organization guidelines for chemical and microbial contaminants as the standard for potable water (Adams 1999). Treatment may be deemed necessary to reduce the possibility of waterborne contaminants. There are three main methods of de-contaminating water – boiling water, adding chemicals, or using water treatment systems. Small treatment systems can be readily put together if the right equipment is available; however, chlorine can always be used as a simple disinfectant.

These simple disinfectant strategies are important when time and resources are scarce. The Environmental Protection Agency (EPA) states that boiling water for one minute (three minutes at higher elevations) will reduce most diseases that are common to contaminated drinking water, such as Giardia and Cryptosporidium. If the water is highly turbid then the water should be strained through a cloth before boiling. Once the water is cool then it can be poured into containers for storage. If the water seems flat after being stored for long periods of time the water can be aerated by pouring it between two vessels to give it some air or add a pinch of salt for taste (Environmental Protection Agency 2006).

If household chlorine is available then it can be used for disinfecting water. Most household chlorine has approximately 5.25% of available chlorine. The following chart from the EPA can help one determine how many drops of chlorine are needed to disinfect a specific amount of water (Environmental Protection Agency 2006).

Table 1: Chlorine for Sanitation

	Available Chlorine	Quart	Gallon	Liter
Drops of Chlorine Needed	1%	10	40	10
Drops of Chlorine Needed	4-6%	2	8	2
Drops of Chlorine Needed	7-10%	1	4	1

Source: (Environmental Protection Agency 2006)

In a time of emergency it is important to note that surface water (i.e. rivers, lakes, and streams) can be easily accessed and sampled for contaminants; however, it should always be assumed that surface water is in fact contaminated. Therefore, it is important to have some type of treatment system in place. On the other hand, groundwater is usually free of contaminants and treatment is usually not needed, although it takes more energy to find and access the water (Adams 1999). As a result, groundwater is usually not used in the first few weeks after a disaster. Springs are also a potential source of water, and although they are ultimately considered a groundwater source, they can be accessed readily. However, in order to avoid surface contaminants in the water, it is important that the water be taken from the first spring in the tributary. Some springs will emerge and re-submerge a number of times before finally emerging to form a small stream on the surface. This allows the water to become contaminated by wild animals, humans, and other sources, which could potentially be harmful if consumed. It is, therefore, crucial that an individual determine the original source of the spring before the water is consumed without treatment.

In Managing Water Supply and Sanitation in Emergencies, John Adams meticulously discusses the acceptable limits for certain types of characteristics in the water. A typical water quality test would measure the turbidity, pH, fecal contamination, and salinity. These traits are vital to understanding how best to disinfect the water, as well as for the duration the water may need to come in contact with a chemical.

Turbidity, otherwise known as the cloudiness of the water; will help determine the type of treatment and the strength of the treatment needed in order to decontaminate the water. The pH of the water demonstrates the acidity or alkalinity of the water. It is important that the pH be kept within a range of 6.5 to 8.5 (Adams 1999). Anything under a pH of 6.5 can be considered corrosive and may corrode plumbing, and metals could be leached out, such as lead, zinc, and cadmium and/or copper. PH higher than 8.5 contributes to scale build-up in pipes and equipment that is made up of calcium carbonate

and salt that is difficult to eliminate (Nova Scotia Environment and Labor 2008; OZ Free 2009). Typical rainwater is a pH of around 5.6, which is slightly acidic, but nevertheless potable. In some cases urban cities in the US the rainwater has been tested and analyzed at a pH of 3, which is extremely acidic and therefore should not be used for potable water unless it is during extreme circumstances (Casiday and Frey n.d.). There should absolutely be no fecal coliforms per 100mL at the point of distribution (Oxfam GB 2004). Lastly, the electrical conductivity that measures the total dissolved solids (TDS) must be considered and is used to find contaminants in the water. For human consumption the conductivity should be no more than 1000 mg/L; however, a taste test would be able to determine if the conductivity is palatable for human consumption.(Adams 1999)

All these measurements can be done simply and cheaply with the right type of equipment. A local health department, water treatment facility, or hospital can help acquire these tools to feasibly measure these particular characteristics.

Water Treatment

Oxfam International is a non-profit conglomerate made up of 13 different organizations that share the goal of fighting poverty and injustice around the world. Oxfam has become an international voice in emergency situations and has developed standards for water treatment systems that can be used in a multitude of different circumstances. John Adams has taken the following information concerning water treatment from the Oxfam's internal guidelines for water treatment in emergencies (Adams 1999). There are three processes to treating and disinfecting contaminated water for human consumption.

The first phase is to pre-treat the water. The pre-treatment process entails passing the water through some type of filter in order to clean out the larger particulates. It is important that heavily contaminated or dirty water is pre-treated before disinfection takes place. If pre-treatment is not an option then it needs to be understood that the disinfection process might not be as effective in treating the water.

The second phase is the coagulation and flocculation phase. This phase facilitates the removal of the sediment that is suspended within the water column. Removing these suspended solids is important to the disinfection process. In order for coagulation to occur, normally alum (aluminum sulphate) is added to the water, which in turn binds the solid particles and removes them from suspension. The intention is to reduce the turbidity to less than 5 nephelometric turbidity units (NTU), which will

ultimately help in the last phase, which is the disinfection process (Cahill 2003). The turbidity of the water should be less than 5 NTU for the disinfection process to work properly. Organic matter clings to the sediment and this matter consumes chlorine. Therefore, it is imperative that sediment is removed from the water prior to chemical treatment (Cahill 2003).

The filtration and flocculation will remove some pathogens that are attached to the sediment; however, not all the pathogens can be removed from the water simply by using these two phases. Disinfection is a key phase to producing potable water. Chlorination is the most commonly used method of disinfection; it is inexpensive, efficient (does not need an excessive amount of contact time), it can perform well in a variety of environments, if used properly it is not harmful to humans, and it can be easily acquired around the world (Adams 1999). Calcium hypochlorite is the form used in many cases, because it is easy to transport and use, and it comes in a granular form with a chlorine concentration of 70% (Cahill 2003).

In extreme circumstances, when the water can neither be filtered nor coagulated before consumption, chlorine may still be used. However, in these extreme circumstances it is important to note that a higher concentration of chlorine will be needed for the water to become disinfected. The disinfection phase should be run by someone who is familiar with chlorine, because an adequate amount of chlorine needs to be added to have a free residual chlorine concentration of 0.2 to 0.5 mg/L (ppm). The goal is to add as much chlorine as needed to have between 0.2 and 0.5 mg/L of residual after 30 minutes of contact time (Adams 1999). For comparison, a swimming pool should generally have a residual chlorine level of 1.5-2 mg/liter concentration. In order to find the appropriate concentration of chlorine, it is best to take samples of the water and add 1% chlorine solution and test the free chlorine residual after 30 minutes (Adams 1999). The free residual chlorine allows the water to continue to have some disinfection power from the time it leaves the place of disinfection to the time it reaches the consumer for consumption (Cahill 2003). The water must always be tested for residual chlorine after 30 minutes of contact time and it also needs to be tasted for palatability (Adams 1999).

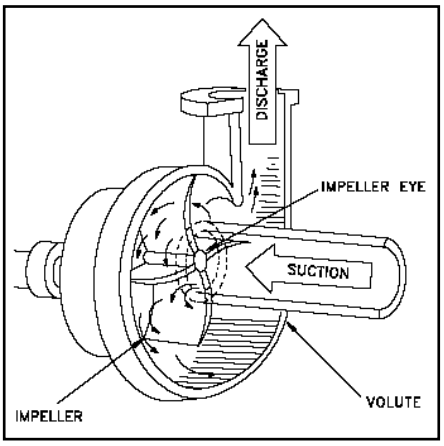
Chlorine is usually added to the water while it is being filled in tanks. This allows the water and chlorine to mix while the tank is filling. It is also beneficial to know that chlorine is more effective at a higher temperature and at a lower pH. The pH should be no more than 8.5. Above 8.5 pH the disinfection process does not work as effectively

and a longer contact time is needed. If the pH is over 9 then hydrochloric acid needs to be added to the water to decrease the pH levels in order to aid disinfection (Adams 1999).

Water Treatment Systems

During the initial stages of an emergency, it is important that water is supplied to the refugees as soon as possible, which means that the water treatment system may be a very simple system. In most circumstances readily available equipment has to be used in order for the treatment system to become operable, which means simple tanks need to be installed near the source of water. The water can be pumped to a tank for flocculation and then on to another tank for chlorination. The fewer pumps needed the better. It is preferable that the water treatment system be located in a location that can gather the water through gravity rather than being pumped from location to location (Adams 1999).

Figure 8: Centrifugal Pump

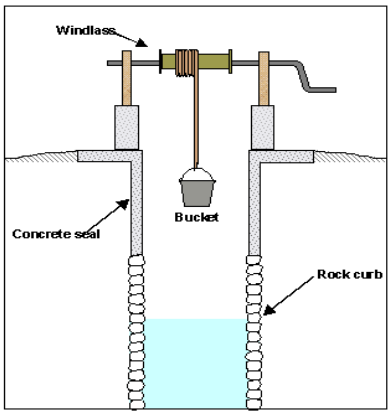


Source: (Engineers Edge n.d.)

Pre-packaged water treatments can be bought; however, these systems are expensive and are usually used only by the military and hospitals. They are usually self-contained mobile systems. In most cases it is easier to put together a system of tanks on your own, because these mobile systems are not able to handle water with high turbidity in most cases need to have extra tanks outside the mobile unit to flocculate and filter the water before being used by the self contained unit. However, in an emergency situation they are nice to have (Adams 1999).

In emergencies with surface-water sources, diesel-driven centrifugal pumps are most widely used because they are inexpensive and lightweight. These pumps, however, can only be used if diesel is readily available. Nevertheless, they are usually used only during

Figure 9: Hand Pump



Source: (Poverty n.d.)

the initial stages of operation and their long-term reliability is poor. If electricity is available then electrical powered pumps can be used. These pumps are both reliable and inexpensive to operate. This is the same for solar powered pumps. If neither solar, electricity, nor diesel is available then the option is a simple bucket and rope system illustrated in Figure 2.2. or wind power. This is especially helpful for low population areas, where there is access to wells (Adams 1999).

Tankers can be used when roads are passable and water needs to be distributed from one population to another or until water treatment systems can be installed in the various locations. This is very expensive and should be a last option due to the expense. The disinfection process should be started when the tankers are being filled with water. It is important, however, with any disinfection process that the water is tested before it is distributed to individuals. The driver of the tanker truck should test for the residual free chlorine before distributing it to individuals (Adams 1999).

Figure 10: Onion Tank

Source: (Interstate Products n.d.)

Tanks and piping should be easily transported and flexible. During most emergencies reinforced PVC tanks are used, such as flexible bladder tanks, pillow tanks, or onion tanks. Onion tanks are the mostly widely used tanks because of their capacity and their depth, which is beneficial in the treatment phases (Adams 1999).

Location

Water points need to be located in areas that are accessible to all individuals. (Adams 1999). Mark Toy, from the Washington State Department of Health presented to a group of colleagues at the Washington State Joint Public and Environmental Health Conference in October, 2008. The presentation covered his work after the Indian Ocean Tsunami in water and sanitation, and he strongly emphasized that accessibility is a key to effectively keeping the water free of contaminants. He had noted that in some camps he had visited that refugees had connected hoses up from their camp houses to the water point storage tanks, which could in effect result in cross-contamination of the water storage tanks. In an ideal situation, water would be dispersed to individuals as opposed to individuals taking from the source, thereby reducing the potential for contamination of the watering point or well (Adams 1999).

Watering points should be no further than 500 meters from a shelter. When water sources are too far, individuals may not utilize them sufficiently to acquire the 15 liters of water day they need. Therefore, it is imperative that the water treatment systems, distribution systems, and water points are all planned out before implementing them (Adams 1999).

Services

Individuals need to be able to have locations to wash clothes and bathe in order to be hygienic in areas where there are a large number of people. These services must be located in areas close to water, but far enough away from water sources and water points, so that the potable water is not contaminated (Adams 1999).

Emergency organizations generally use a ratio of one shower to every 500 people as a guideline when setting up camps. The male and female showers should also be separated from each other. Showering stalls should be cleanable and private (Adams 1999).

Laundry facilities need to available for individuals. In promoting good hygienic practices it is important for individuals to understand the necessity of laundering their clothes. There should be at least one laundry basin for every 100 individuals to give people the chance to was their clothes (Oxfam GB 2004).

Hygiene

Hygiene is probably the most critical step in insuring a clean water supply. The World Health Organization estimates that 1.8 million people die each year from diarrhea and 88% of those diseases are caused by contaminated water, inadequate sanitation and hygiene. Hygienic standards can be maintained by keeping latrines and solid waste facilities away from water collection and points of use and by providing access to cleaning facilities after defecation.

It is imperative that soap be distributed among the refugees for hygiene. This helps reduce the number of public health issues that may crop up due to poor hygiene. Ashes or mud can also be used; however, soap is more effective and tolerable for more people. Each person should have approximately 250g of soap per person per month. It is important that soap be used rather than detergent when washing clothes, because detergent has been known to block waste-water disposal systems (Adams 1999).

Feasibility

Providing water is a quintessential component in managing environmental services after a disaster. Water is necessary to the victims' survival be it the quality and quantity. If the victim does not have enough water then their survival is jeopardized, and if the quantity is insufficient then the risk of dysentery is a major concern. It is the short term, as well as the long term health of the individuals in our communities that take precedence.

Fortunately, in western Washington we have an ubiquitous amount of water that is available year round in streams, ditches, lakes, rivers, estuaries, etc. All these water sources can be used.

The water treatment systems and the water points need to be thoroughly planned before implementing them. Sources and treatment levels need to be clearly identified before water can be distributed. It is imperative that the water is not consumed by individuals until the water has been deemed potable by a health official. Water is a key to life and the survival of refugees during a disaster.

Sanitation

Proper solid waste and excreta disposal is paramount to a healthy population and environment. Some researchers have considered excreta disposal the single most important activity to prevent illnesses within disaster recovery areas. Therefore it is paramount that excreta disposal areas and/or latrines be set up as soon as it is feasible to do so and in most instances takes precedence over building water treatment facilities. Latrines give people a place to relieve themselves in privacy and give public health officials some comfort in knowing that individuals are not defecating out in the open areas where the excreta could be potentially harmful.

Solid waste encompasses many forms of waste, and therefore, it is vital that one thinks of all the different forms whether it refuse, food waste, or grey water from kitchen facilities and clothes washing, etc. In many cases it is crucial to keep the solid waste separated from the day to day activities of cooking, drinking, and living around the camp. The health of the individual in the camps may not be directly tied to solid waste, but it can indirectly impact the health of individuals through vector problems or just the mental health of individuals living in a cluttered environment.

John Adams in Managing Water Supply and Sanitation in Emergencies mentions that one of the most important emergency response priorities is to provide latrine facilities for individuals as soon as possible. This helps contain the excreta and reduces the concern for contamination, as well as relieves the stress by giving victims a place to defecate and gives them some self-respect that is important in such extremely stressful situations.

Health Consequences

Excreta related illnesses are one of the most common forms of illness among victims of large disasters. In most cases the excreta is transferred through what public health officials call "the fecal-oral route", which means an individual has ingested excreta that is contaminated with microorganisms through hand-to-mouth contact, and/or food and drinking water supplies (Centers for Disease Control and Prevention n.d.). In many cases it is an individual's hygienic practices that determine whether or not the individual will be susceptible to such diseases.

The diseases most often associated with the fecal-oral route almost always cause diarrhea of some kind. There are a variety of different diseases ranging from cholera, shegella, hepatitis, typhoid fever, amebiasis, campylobacter, E-coli, giardia, which can be seen in appendix A (National Association for Home Care & Hospice 2005). These particular diseases could all be potential diseases here in the Pacific Northwest and are all fecal-oral related.

In order to prevent these diseases from occurring, it is imperative that excreta is kept away from water and food distribution areas. It is also important that public health education measures are taken to enhance people's understanding of the importance of good hygiene. Good hygienic practices have been thought to be one the most important key issues that public health officials can make during an emergency event. The improvements to water systems and sanitation stations are useless when not used with good hygiene practices. Emergency organizations have found that public health officials need to aim their educational campaigns at making sure individuals are defecating in areas reserved for such activities and/or if they are defecating in buckets that the excreta is disposed of properly in identified areas, as well as hand-washing facilities available in appropriate locations (Adams 1999).

Disposal Systems

Planning

The planning process is important to ensuring the public's health by adequately distancing the latrines from the water sources and well points. Yet, the latrines need to be close enough to the shelters that individuals will use them without finding their own private location to defecate. There should be at least one latrine for every 100 people during the first days to weeks following a disaster, and as soon as possible that number should be increased to one latrine to every 50 people. Some organizations have noted that the latrines should be located within 100 feet of the shelters or an adequate distance. Over the weeks and months following a disaster, each individual family should have a pit toilet within at least six meters or their shelter and still an adequate amount of distance between the shelter and the water source and well points (Adams 1999). An adequate distance is a rather general term when thinking about distances, but each location is unique, and therefore those individuals with expertise should help provide some insight into what an adequate distance is. But it is important to keep excreta disposal areas and latrines at least 50 meters from rivers, streams, and lakes, as well as away from water treatment and storage facilities, along well-traveled roads and paths, and away from food storage and preparation. The topography, surface water, ground water, and soils can all contribute to how fast the effluent will move through the soils, which may eventually contaminate the water source. The disposal areas should be downhill of all the areas listed above to prevent contamination (Adams 1999). If the soils are sandy then the effluent from the latrines are much more likely to move through the soil faster than if the soils is nicely structured loamy soils. However, if the latrines are set in soils with mostly clay then the effluent is much less likely to penetrate the soils and will rise to the surface much faster.

Accessibility

The latrines need to be able to be accessed for cleaning purposes on a regular basis by individuals designated to those duties; as with any type of functional operating system they need to be maintained to continue operating correctly. Access may be as simple as accessing the latrines by wheelbarrow or buckets and not necessarily someone with a septic pumping tank. If these systems cannot be accessed then the problem of the systems overflowing is a concern (Adams 1999).

Those individuals that are disabled need to collect their feces in a 5 gallon bucket and then manually have someone carry that bucket to the disposal areas – called the bucket latrine method. These buckets should be emptied daily for hygienic and sanitary reasons (Adams 1999).

Systems

There are a number of different excreta disposal systems that will work in emergency situations. These systems consist of existing facilities, defecation fields, shallow trench latrines, pit latrines, and sewage containment/treatment facilities.

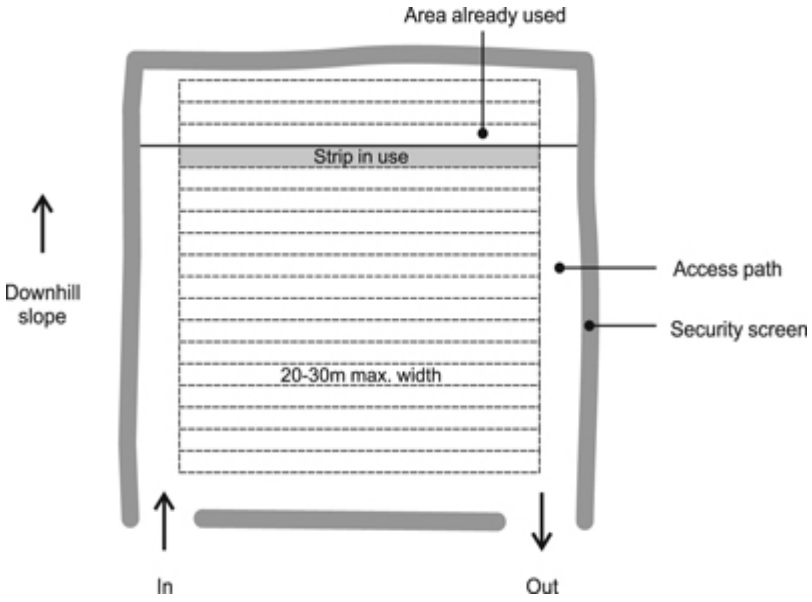
The assumption is that during a large earthquake and/or tsunami event that the sewage treatment facilities will be destroyed. However, in many cases sewage treatment facilities are in low lying areas, as in the case of Pacific County. Therefore, they will most likely be inundated with water. Private residents that are on their own on-site treatment systems may be able to use their facilities if they have running water. The assumption again is that there may not be any electricity and that the water treatment facilities will not be available; therefore, water will need to be manually put in the toilet bowls in order to flush them properly. Sewage systems are estimated to use approximately 20-40 liters of water per user; therefore, that much water will need to be manually brought in to the household (Adams 1999). Many newer on-site septic systems (OSS) are not gravity fed and therefore need some type of electrical system to properly move the effluent from the tank to the drainfield by a pumping mechanism, which would make them inoperable in time of no electricity.

Defecation Fields

Defecation fields should only be used for a very short period of time due to the high risk of disease. These fields are very simple due to the fact there is no digging or walls to be put up other than fencing to enclose the field. Therefore these can be made rather quickly. A defecation field needs to be an area where individuals can go without contaminating any water or food supplies, but still close enough to the shelters, so an individual will use it. In some cases it might be necessary to put up a fence line that restrains people from defecating outside the field. The area would need to be strictly monitored, so that the vicinity is used properly by the victims. The management of the systems is important, because it is imperative that one strip of land be used at a time, so as not to waste too much space. To make this straightforward for an individual using the

field, monitoring staff can place flagging by the strip that is in use. Once the strip has been filled with excreta then the next strip can be used and so-on-and-so-forth. It is important that the victims get as close as possible to where the last person excreted in order to not waste space. If there is enough space then several defecation fields should be set up, so that there can be some separation between the sexes (Reed and al. 2005).

Figure 11: Defecation Field



Source: World Health Organization (Reed and al. 2005)

Excreta fields are not meant to be used long-term due to the nature of the excreta sitting out in the open. These fields are also not meant to be re-used unless the excreta can be covered with soil or disinfected. These fields are only to be used as a temporary solution until latrines can be built (Reed and al. 2005).

An ample area must be allowed for the population to be using it. For instance on a defecation field approximately 0.25 m^2 (500x500 mm) per day per person should be allowed. Extra space will need to be provided for the access paths. For 1,000 people an area of 25 m^2 would be needed (Adams 1999).

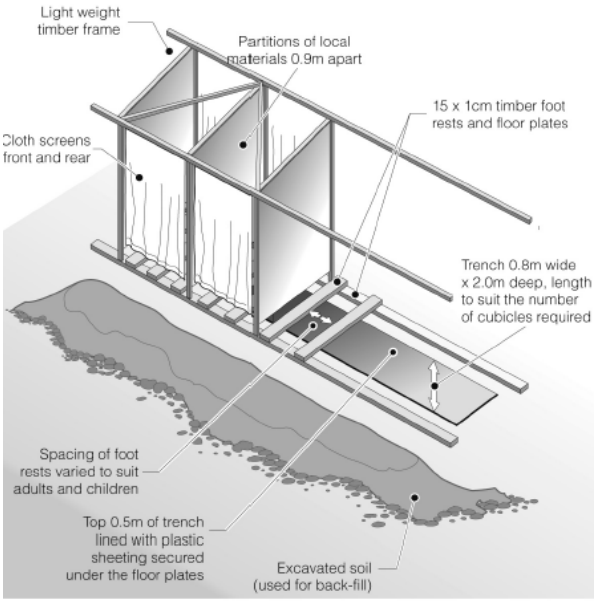
Trench Latrines

If the situation is going to last for some time, then each family should have their own latrine; however, in the first couple of weeks following a disaster there is no need to provide each family with a latrine. The key during the short-term, however, is to provide a place for excreta disposal.

The trench latrines are more convenient and hygienic than excreta disposal fields. These latrines are similar to the defecation field in that all the latrines are in a certain area; however, instead of defecating straight onto the ground in parallel lines, long

trenches are dug along parallel lines. The idea is to defecate in the trench and not straight onto the ground. This allows for more excreta to be collected in an area and, therefore, the same location can be re-used a number of times. The larger the area the less chance of cross-contamination for both the defecation fields, as well as trench latrine areas, providing the site is well managed and monitored (Adams 1999; Reed and al. 2005). Defecation trenches need 3.5 m^2 of trench per 100 people (Adams 1999).

Figure 12: Trenches for Latrines Placement

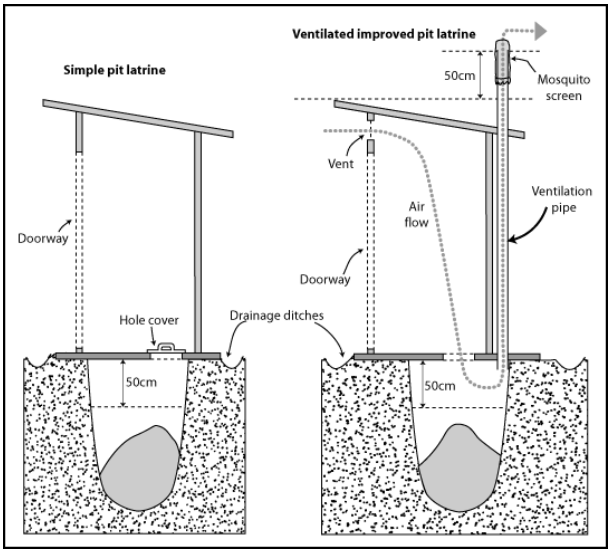


Source: (Reed and al. 2005)

The trench should be dug at least 2 meters deep or as deep as possible. The trenches can be up to 5-10 meters in length and 1-1.5 meters wide. This allows for a substantial amount of space for the excreta. In some cases the trenches will need to be lined with timber in order to give the trenches a bit more stability as in Figure 12 (Reed and al. 2005). Planks will need to be laid perpendicular to the trench in order for an individual to be able squat over the trench, which is sometimes referred to as the "eastern style" because historically Asian cultures have squatted when using latrine facilities.

These trenches are labor intensive, and those in charge of supervising them need to stay vigilant on making sure the community is using the latrines in a proper manner and that the facilities are being managed so that excreta is

Figure 13: Trench Latrines



Source: (In the Wake 2008)

covered each day to manage insects and to keep the area clean and uncontaminated. If individuals are not using the latrines then the risk of disease becomes more of an issue (Reed and al. 2005).

The trenches need to be covered with 100-150 mm of soil each day and when a trench is finally full, at least 300-500 mm of compacted soil needs to cover the trench. Therefore, the trenches have to be continually monitored, and each day old trenches need to be covered and new trenches need to be dug (Reed and al. 2005).

Safety

For the safety and security of both sexes, it is important to have two disposal areas -- one for males and the other for females. It is also essential that once the trench latrines are created that there be some type of privacy wall around each individual latrine. These areas should also be lit at night to provide some security for the individuals using the sites. This allows both populations to use the facilities at all times, day and/or night which leads to more sanitary circumstances directly around the sleeping facilities (Adams 1999)

Management of Disposal Areas

If defecation fields have not been set up or it is impossible to create such a field, then it is important to make sure that fecal matter is being cleaned up periodically around a camp, roads, and other areas where people may be staying. Individuals should be assigned the task of making sure the fecal matter is being cleaned up regularly and educating the community on the significance of defecating in particular areas that have been assigned for those activities. The assigned individuals will need protective clothing, tools, and washing facilities in order to do the job; it is imperative that the individual does not come in contact with the fecal matter, and if they do, that they are fully protected where nothing will get on them. Once the feces has been collected it can either be disposed of by burying it in a hole with at least 300-500 mm of compacted soil over the top or be disinfected with lime, which will dry out the feces and will keep insects away, reducing the amount of vector control that may need to be done (Adams 1999).

Solid Waste

Planning

Solid waste is usually not a priority directly following a disaster, and therefore, emergency response workers only need to think about it after the latrines and water treatment facilities have been built. Solid waste is a combination of food scraps, packaging, health care materials, and other items that may need to be disposed of. These items could be potentially harmful, especially if the items are coming from a health care center, where material are sometimes hazardous and need to be disposed properly. Such materials include syringes, and blood stained items, which typically need to be disposed of in "Biohazard" boxes and bags (Adams 1999).

The waste is generally not considered harmful unless the waste needs to be contained with a biohazard box. The waste is usually directly related to vector control problems and in order to prevent the vectors from using the waste as habitat it is imperative to reduce the solid waste and to have a location where the solid waste can be disposed of (Adams 1999).

A large disposal site should be sited approximately 500 meters away and downwind of living areas. It is important that the site is at least 50 meters from any water points and it is downhill of any potential water sources. All disposal pits, no matter how large or small, should be at least 1.5 meters above the water table in order to allow some time for the liquids to leach through the soil before they enter into the ground water (Adams 1999).

Community Involvement

The community needs to be involved in the planning process for latrine placement because if the community is neither educated on the importance of proper excreta disposal nor realize the ramifications of not keeping areas sanitary, full cooperation may not be given. Continued management and education needs to be done throughout the process. For instance if the victim culturally does not squat at their latrines, they may be uncomfortable and not use the latrines; therefore, it is important to get public input and suggestions before planning. Therefore, public outreach following a disaster is key to a successful environmental health initiative (Adams 1999; Reed and al. 2005).

Accessibility

Victims should not be responsible for solid waste management, especially after being traumatized by a large disaster. An agency should take on the responsibility of discarding and disposing of unnecessary items that may be a potential environmental health issue, as well as a nuisance. In a disaster where solid waste is not a priority then individuals can either dig a refuse pit near their camp or an agency can wheelbarrow the items to a refuse location that can be used for all collection. Each household should have at least one refuse container or garbage bags to contain all their solid waste. Roadside containers can also be used for collection sites. One 55 gallon drum should be allocated to every 10 families and it should be disposed of twice per week or more as needed (Adams 1999).

Hygiene

Researchers have suggested that hygiene education and promotion can have as great an impact as improvements to water quality and sanitation, but should never be substituted for potable water and good sanitation practices. The education is an essential part of teaching individuals to defecate in certain areas in order to discourage diseases and pathogens from entering the human environment. This incorporated with hand-washing activities is paramount to eliminating the potential exposure to new pathogens. The means to prevent transmission of diseases is to effectively work with the community and put the onus of their health and their community's health back on them and educate them on how to do this. It is up to each of them to take action in promoting good hygiene practices. It is imperative throughout this process that the community be a stakeholder in the decision making process and that they take the responsibility of educating their communities (Adams 1999; Oxfam GB 2004).

Education

Hygiene education needs to be boiled down to a few very simple key points that can be illustrated and taught very quickly to the disaster victims, such as handwashing with soap after defecation, using designated defecation sites, and boiling water. These simple educational tools can be used to help deter the transmission of diseases. However, the message will not become instilled in the individuals unless they all have access to the resources and facilities to make it all happen, which would be access to clean water for

handwashing, soap for cleaning, and access to an energy source so water can be boiled. This goes for all of the hygienic points that health officials would need to make. The education needs to start prior to a disaster, so people understand the importance of proper hygiene (Cahill 2003).

Food

There is very little published information regarding food supplies and nutrition during a disaster, and in most cases if people have potable water to drink then suffice it to say they will not need as much food. It is also assumed that food is one of the items that can be dropped into areas from helicopters, and therefore, will come much sooner than other services.

Food can be found at a number of locations: individual residences, school kitchens, food distribution centers, etc. As long as the food has not been spoiled or contaminated, it should be safe for consumption. It is important that if the food has been sitting in the refrigerator or freezer that it is still cold and below 41 degrees Fahrenheit in order reduce the potential for bacterial growth, which reduces the possibility of consuming bacteria that are hazardous to the immune systems (Washington State Department of Environment Health 2009).

Improper food storage can lead to certain types of bacteria, such as *B. cereus*, *C. perfingens, Salmonella, S. aureus, Streptococcus*, and other bacteria that can be potentially deadly if not treated properly, and in most cases, it is smart to just avoid consuming these bacteria by keeping the food stored properly (Landesman 2005).

When preparing for a disaster, all households should store at least a three-day supply of food, and now emergency management supervisors are telling individuals to store at least a seven-day supply. These foods should be made up of canned foods and dry mixes, which have a longer life expectancy than items that need to be refrigerated. It is important to keep these canned and dry foods in dry, dark areas, where the temperature does not go below 40 and above 60 degrees Fahrenheit. These foods should have a life expectancy of up to about two years at which time all the food should be turned over for a newer supply (Landesman 2005).

If there is no power then refrigerators and freezers will eventually warm up and temperatures will begin to rise and the potentially dangerous foods, such as dairy products and meats will eventually reach the “danger zone”, which is between 41 and 140

degrees Fahrenheit. Foods in the danger zone should not be eaten unless food has just reached the danger zone and at that point should be eaten immediately. Logically, fresh food should be eaten sooner than the dried and canned foods that are sitting in the cupboard. Unrefrigerated foods should not be out at room temperature for longer than six hours; after that time they need to be put in the garbage. Refrigerators and freezers can be kept cold through some type of power supply, whether electrical, propane, or a generator that is hooked up outside the house. If blocks of ice or dry ice are available they can be added to the refrigerators periodically to the outside if there is no power supply available. A 25 pound block of dry ice will keep a 10 cubic foot freezer below freezing for three to four days depending on the outside temperature (Landesman 2005) (Washington State Department of Environment Health 2009).

Contamination

All foods that have been touched by flood water (i.e. tsunami) must be discarded unless they are in a sealed or air tight packaging. These items don't necessarily need to be discarded but do need to be washed and sanitized before being opened. The labels need to be taken off and discarded, and the cans themselves should be washed in warm water with detergent, rinsed, and then soaked in a 10 ppm solution of bleach (1 tsp bleach to 1 gallon water) for at least 2 minutes before being opened and consumed (National Safety Council 2009).

All cookware and utensils that have come in contact with floodwater need to be decontaminated by boiling and/or washing and sanitizing just as the sealed food packages. If there are items that are chipped or cracked, these items need to be discarded due to the fact it is more difficult to decontaminate these types of pieces. It is also important to discard items such as baby bottles, nipples, and other such items that may not be able to be decontaminated very fast or easily (National Safety Council 2009).

Dissemination of Information

If media is available then the message should certainly be disseminated through whatever media source is available. However, mass media may not be available during a large disaster; therefore, to rely on mass media alone would be a terrible mistake. In small communities where the media may not be able to reach victims, face-to-face interactions should be used, through small workshops, information distribution of

brochures, or face-to-face on the ground interaction. It is most likely a combination of all these points that will be needed to get the information across (Cahill 2003).

Shelter

Temporary settlements give individuals a place to go after a natural disaster. During the post disaster period a large portion of people are thought to spend at least some time in temporary settlements. Research has found that victims affected by disasters are thought to stay in unplanned settlements, rather than those that have been carefully planned and organized prior to such an event. It is wise to think about the long-term temporary settlement requirements and not just the short-term. In many cases it would be astute to shelter individuals in short-term settlements and then move them to more long-term settlements once they have been organized. (Adams 1999)

Planning Process

First and foremost, a settlement should have topography that allows for a temporary settlement to be placed there and access to a water supply. In the case of an earthquake or tsunami, it would be important to think about the consequences of locating a settlement in low lying areas. So often earthquakes and tsunamis are not limited to just one event but continuously happen throughout the days and weeks after the initial tsunami, so the security of the victims is a priority, as well as the access to the water and sufficient space for shelter, as well as drainage and sewage disposal (Adams 1999).

Within two weeks after a major disaster, it is important to have some type of settlement in place, but the necessity of having to think about a location being used for the long-term is not yet a priority. In the short-term the following are important key points:

- water supply and an area for small scale treatment facilities;
- an area for latrines and defecation fields;
- an area for solid waste that will accumulate from food packaging and excreta disposal;
- a space for burial grounds in case of deaths;
- an area away from vector producing areas;
- an area where the drainage is good and run-off will take place;
- an area for hygiene, where people can take care of their basic needs.

However, the most important key point in the short-term settlement is that there is a water supply that is large enough to supply the affected population with potable water after treatment and an area for defecation and excreta disposal (Adams 1999).

In the immediate aftermath of a disaster, it is important that each victim has some type of temporary shelter. The type of temporary shelter depends on the climate, time of year, and what the population is used to. In the short-term, each individual should have at least 3.5 m^2 of space per person. In the very short-term this may not be feasible due to the lack of shelter and large population needing some type of shelter; however, it is imperative that as soon as it is feasible to do so, the victims acquire the 3.5 m^2 needed to live comfortably for a short while. The shelter should include a roof, safety and privacy, and ultimately a place where an individual can live comfortably in the short-term (Oxfam GB 2004).

Vector Control

Vector and pest control is requirement to curb any diseases that may spread after a significant disaster. Vectors are usually insects, such as mosquitoes and flies and pests can be anything that causes a disturbance. However, in most cases they are rats and/or mice. It is important that these vectors and pests be managed properly as they emerge after a disaster, since there is usually a failure to keep all the environmental controls in place after a disaster (Landesman 2005).

Pests & Vectors

In the Pacific Northwest, there is very little concern for vector-borne diseases, such as typhus, yellow fever, dengue fever, sleeping sickness, or river blindness that are prevalent in the more tropical areas of the world (Adams 1999). In the Pacific Northwest there are hardily any vectors or pests that are a terrible concern in the first couple of weeks following a natural disaster.

The one vector that could potentially be a problem is West Nile Virus (WNV). It can cause serious health concerns and can at times be fatal. WNV is carried and spread by mosquitoes. The risk of infection is very low; however, anyone can become infected. Those individuals in the more susceptible populations are young children and adults over the age of 50. In the Pacific Northwest there have been a limited number of infected humans; since 2002 only 6 cases have been identified in Washington State and 125 cases

in Oregon State, though most of the cases in Oregon were documented in eastern Oregon (Oregon Acute and Communicable Disease Prevention Program 2009; Washington state Department of Environment Health 2009).

Pests, such as rats and mice could carry two known diseases that have been found here in the Pacific Northwest. One is the plague and the other is Hanta Virus. Plague has been documented only in one person in Washington State, since 1907 and that was a trapper in 1984. Oregon, on the other hand, has only been tracking since 1994; so far only one victim has been documented in 1994 (Oregon Acute and Communicable Disease Prevention Program 2009; Washington state Department of Environment Health Zoonotic Disease Program 2009).

Hantavirus, on the other hand, is more common. It is carried by rodents, with the deer mouse being the most common rodent in the Pacific Northwest to carry the virus. The virus is very serious and mimics the flu with symptoms such as sore muscles, headaches nausea, vomiting, and fatigue. The virus is normally found in rodent droppings, and it is the dust from these droppings that usually cause Hantavirus Pulmonary Syndrome (HPS). One in three people that develop HPS die from it. Washington State Department of Health Zoonotic Disease Program receives approximately 1-5 documented reports of individuals succumbing to HPS each year whereas Oregon State has only had 9 cases between 1993 and 2007 (Oregon Acute and Communicable Disease Prevention Program 2007; Washington State Department of Health 2009).

Community Control

Vector and pest control is key when there has been a lack of environmental controls, such as in the aftermath of a disaster. Control does not necessarily mean controlling the environment with poisons, but using an intergraded pest management (IPM) method, which uses simple techniques that the surrounding community members can easily incorporate into their daily lives, such as good sanitary disposal and good hygienic practices. The key is to remove any sources of food or harborage that the pests can use for their survival (Landesman 2005).

Burial

During a natural catastrophic event, such as the Asian Ocean Tsunami in 1994, there may be mass fatalities in a number of countries. A large number of fatalities in one

area can cause havoc on a public and emergency management system that is not prepared. The Director of the Pan American Health Organization, Mirta Roses Periago stated it best in that "management of the dead is one of the most difficult aspects of disaster response" (pg. V). The fact is that local jurisdictions are responsible for the initial response (Morgan, Tidball et al. 2006).

Large areas for burial will be needed if it is a mass casualty event, assuming infrastructure is still in place to transport victims to the site. However, if infrastructure has been destroyed and there is no way for an individual's family to make it to a per-designated burial site due to loss of infrastructure, then the family needs some means of burying their loved ones. Family members will need information on how to bury their loved ones and where. Documentation on where bodies were buried will need to collected and compiled later after infrastructure has been restored and the population is once again mobile. How do we go about burying loved ones and who is responsible for the process?

Federal Response

At the federal level of operation there is a Disaster Mortuary Operational Response Team (DMORTs) that works under the National Disaster Medical System (NDMS). The team is responsible for victim identification and morgue services and is made up of private citizens (i.e. funeral directors, medical examiners, and coroners), who would ultimately work under the local health officials' direction and would help supplement the tasks that were needed to have been done by the local coroner. These team members bring their own equipment but have access to one of two Disaster Portable Morgue Units (DPMUs) in the country. These units are filled with pre-packaged equipment and supplies that would be needed at a site (Landesman 2005; U.S. Department of Health & Human Services n.d.).

Local Jurisdiction

In the case of mass fatalities, the local jurisdictions are responsible for the response, and only when local resources have been exhausted will the state intervene per the state's Emergency Support Functions #8 "Mass Fatality Incident Report" with resources and logistical support (Emergency Preparedness Unit 2008). In the case of an event the Pan American Health Organization believes that it is important for one person

to be the coordinator and that it should not be the local health or hospital officials, since they are responsible for working with the victims that are alive, not dead (Morgan, Tidball et al. 2006). The local jurisdictions are required to have a plan and protocol in place to deal with any type of event that may cause mass casualties, which is ultimately the responsibility of the coroner. However, in small counties with a population less than 40,000 people, the local jurisdiction is not required to elect a county coroner per RCW 36.16.030, which states that "no coroner shall be elected and the prosecuting attorney shall be ex officio coroner". Therefore, the prosecuting attorney of the county will be responsible in the case of mass fatalities. The county commissioners are responsible for the burial of any individuals that are indigents and are not claimed by family or friends per RCW 36.39.030 (Emergency Preparedness Unit 2008).

Burial

It is important to note that dead bodies do not cause public health epidemics. In natural disasters it is very unlikely that individuals have died carrying with them some type of disease such as the plague, typhoid, or HIV. Most of these diseases don't last longer than 48 hours, with the exception of HIV, which has been known to last up to six days. The Pan American Health Organization has found that the myth of dead bodies causing public health outbreaks is encouraged by the media, which in turn puts political pressure on those in charge to take drastic measures such as creating mass burial sites and disinfecting all the bodies. This can cause undue anxiety and mental stress for the family members; it is much more likely that "the surviving population is much more likely to spread disease" (pg. 5). There is some concern that dead bodies can contaminate the drinking water supplies by the feces they discard postmortem; however, this has not been researched and documented at this point (Morgan, Tidball et al. 2006).

Cold storage from 2 to 4 degrees Celsius (36 to 39 degrees Fahrenheit) is optimum and a necessity, especially in a hot climate where bodies tend to begin to decompose in a matter of 12 to 48 hours. Bodies need to be stored in bags or in sheets to keep the body parts together. Each body should also be identified with a sheet of paper in a sealed plastic bag. The body should not be identified with a marker on the body due to the fact the body will decompose, losing the identified marker (Morgan, Tidball et al. 2006).

Temporary burial can be used to help keep bodies refrigerated since the ground is cooler than the outside. In this case trenches should be used. The bodies should be

buried at least 1.5 meters (4 feet) down and 200 meters (600 feet) from drinking water sources. The bodies need to be roughly 0.4 meters (1.3 feet) from one another (Morgan, Tidball et al. 2006).

Dry ice can be used for refrigeration but roughly 10 kilograms (22 pounds) of dry ice is needed per day to keep the bodies sufficiently cold. The key is to build short walls about 0.5 meters (1.6 feet) tall around about 20 bodies and encase the wall with plastic. The use of ice, frozen water, should not be used at any time due to the fact it can damage the bodies more and creates water, which can lead to a dirty mess (Morgan, Tidball et al. 2006).

Permanent graves should be clearly marked and be at least 200 meters (600 feet) from drinking water sources. The more bodies that are buried in a certain area, the farther they need to be from drinking water sources.

Table 2: Recommended Distance of Graves from Drinking Water

Number of Bodies	Distance from Drinking Water
4 or less	200 m (600 ft)
5 to 60	250 m (750 ft)
60 or more	350 m (1050 ft)

Source: (Morgan, Tidball et al. 2006)

The graves should be at least 1.5 to 2 meters deep (5 to 6 feet) and approximately 0.4 meters (1.3 feet) between each body. Graves should be at least 1.2 meters (4 feet) between the water table and the bottom of the grave, and in sandy soils it should be at least 1.5 meters (5 feet)

Risk for Handlers

For those individuals with the responsibility of handling dead bodies, it is important to take precautions such as wearing gloves and boots, washing with soap and water and avoiding touching the face or mouth with their hands, and disinfecting all equipment and clothes after coming in contact. The reason for this is that dead bodies can carry such disease as Hepatitis B and C, HIV, Tuberculosis, or diarrheal diseases. These diseases can be in the blood stream and/or in the fecal matter that is excreted after death (Morgan, Tidball et al. 2006).

Identification

It is important that all the information identifying a person should be collected as soon as possible. This can be done by gathering photographs and identifying simply what the person was wearing and what they looked like in the way of clothes, body building or facial features. As much information as can be provided should be written down and placed in a sealed plastic bottle next to the victim. This will help the forensic specialists once they arrive on the scene (Morgan, Tidball et al. 2006).

DISCUSSION

A comparison of the case studies demonstrated that in each of the events that were reviewed a lack of communication and coordination between agencies and organizations was a key criterion when looking at the inefficiency leading to disorganization of the provincial and central governments. In the two cases of the Great Hanshin Earthquake in Kobe, Japan, and the Asian Ocean Tsunami in coastal Sri Lanka communication lines were severed due to the nature of the disasters; however, once communication was linked between the agencies in the area in each case, the government agencies were able to supply the necessary environmental health services to the victims within the first week of the disaster.

Again, in the case of the two large unexpected disasters in Japan and Sri Lanka, it was the ad hoc volunteer groups that were created in the moment, which supplied individuals with food, water, clothing, and shelter in the first few days after the disaster. Hurricane Katrina, on the other hand, was expected and therefore when residents could not leave the city of New Orleans there were no other community members left to help in the rescue phase. It was left up to the local agencies to provide the service that in other cases was provided by the individual community members.

Pacific County's response during the 2007 windstorm was identical to the other case studies; the lack of communication was a key factor. The public felt it was necessary for the government to keep all lines of communication open in order to provide outreach to the community, especially those that needed food. Also, the communication between the federal agencies, such as the National Guard and local agencies needed to have been better. If the lines of communication are open the more fluid and seamless the response. The important point made in this case study was that the public felt isolated

from the rest of the world and felt the lack of communication between the government agencies working to provide services and the media that did not respond to the event made the isolation they felt more intense. It is this isolation that would be more pronounced in a larger disaster, because not only would Pacific County be affected, but possibly all the jurisdictions in western Washington.

The emergency response plans were put to the test, and for others such as the Sri Lankan government that had no plan, it was a learning experience. These agencies have since then all reviewed their emergency response structure. It is the delegation of authority, and responsibilities that have all been identified in case another catastrophic disaster strikes again. Within this delegation of authority one key component is the overwhelming issue of public health. That the vast number of deaths and injuries in each case exceeded the capacity of what hospitals and public health officials could respond to is a primary focus for all three governments. It is the larger disasters that need to be evaluated and prepared for, not the smaller ones. Once a larger disaster has been prepared for, it is easier to handle a smaller disaster. Educating the community members is also important, so they learn what can they do and how can they prepare themselves. However, the resources that are needed to prepare for such a disaster is overwhelming for many smaller government entities such as Pacific County that sits on the southwest corner of Washington State.

In a discussion with Dr. David Burke, the Prosecuting Attorney of Pacific County, he mentioned that the county neither has the resources nor time to plan for mass fatalities. The cost of buying body bags and planning for a disaster that may never happen in our lifetime is a misuse of county resources when budgets are already tight.

A number of other officials from around the state have stated, in anonymity, that they believe that the federal government will provide the response that is needed. Some have mentioned the federal government will rescue everyone by evacuating everyone by plane. In the case of a large earthquake and/or tsunami, rescue efforts may not happen or if they do it may take days or weeks afterwards. The National Response Framework specifically states that it is the local government's responsibility to protect and respond to its citizens.

Other officials suffer the misunderstanding that they are not responsible in the case of mass fatalities, that either the federal government or a non-profit group such as the Red Cross will step in and take over the burial of individuals and the identification

process. Again, this is a misconception, and information has not been relayed to the proper individuals.

The governments will be able to respond; however, the response may not be as coordinated as it may need to be. With not enough time and resources, the local governments are in no position at this time to realize the task they may have in front of them if a disaster does strike and to respond to it in a coordinated effort. Coordination takes effort and time. The small local government's emergency response managers are working very hard to plan, but to coordinate all the stakeholders is a enormous undertaking when the local governments and agencies and organizations involved have dwindling financial and personnel resources.

The state departments are fully aware of the issues that are facing the local governments. Cindy Gleason, the Preparedness Section Supervisor with the Washington State Department of Health, is fully aware of the difficulties that small local governments are facing and is trying to provide the local governments with as much information as they need to plan and respond to disasters. She is undertaking the task of providing local governments with some guidelines to deal with mass fatalities at this time. She commented the difficult part is that each government has their own stakeholders and each government runs just a bit differently; therefore, creating guidelines that will work for everyone is not feasible. However, as she stated, the local governments are trying to do what they can and hope that the Department of Health and other organizations can continue to support the provincial governments in preparing themselves.

CONCLUSION

The chance of a large disaster striking the Pacific Northwest is inevitable and something that everyone living in the Pacific Northwest needs to prepare for. The only trouble is that no one knows when it's going to strike. It could be tomorrow or 500 years from now. However, emergency managers need to start preparing now, so by the time it strikes, local governments will be fully prepared to respond to the needs of the victims in a coordinated manner.

Environmental health services need to be planned by each local health jurisdiction. Victims may be able to store food and water for seven days, but if their house is destroyed by an earthquake and/or tsunami, then these basic necessities need to

be provided by the government or non-profit organizations in the area within a day or two of the disaster.

The planning will need to incorporate locations for shelters, temporary burial sites, and excreta disposal. Water sources will need to be found in order to provide individuals with potable water, and locations of food sources and power to keep the food from spoiling need to be sought. These locations and sources need to be determined by each local jurisdiction because of the unique topography and needs of the community.

Preparing for an eventuality when resources are scarce is difficult, but if each local entity takes it upon themselves to prepare themselves, albeit slowly, then ultimately a response plan will be coordinated between the stakeholders in the community, and the local governments will be well prepared for a coordinated response.

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