METHODS TO WARN AND INFORM BEFORE, DURING, AND AFTER AN EMERGENCY

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Abstract

The Contingency Planning Unit of the London borough of Hounslow is looking to expand and improve their current emergency communication system to effectively warn and inform its dynamic, transient, and diverse population. Through archival research and interviews with emergency management organizations and academic experts, we analyzed various communication options and evaluated public response and the importance of the warning message. We concluded that Hounslow should use multichannel communication to warn and inform its population before, during, and after an emergency.

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Authorship

The three students listed on the cover of this report contributed equally to its content and revision.

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Executive Summary

Hazardous events can cause severe damages to a community and its infrastructure. For example, the 2003 European heat wave resulted in over 2,000 deaths in the United Kingdom (UK), mostly affecting the elderly, the very young, and the chronically ill. During the 2007 severe flooding in the UK, over 55,000 homes and businesses were inundated, of which 35,000 received no early-warning. Regardless of the situation, emergency management organizations must communicate with the public.

The UK government believes that a well-informed public is better able to respond to an emergency, minimizing the impact on the community. Therefore, under the Civil Contingencies Act of 2004, Local Authorities have the duty to warn and inform the public about emergencies.

The goal of this project was to develop a toolkit of methods for the Contingency Planning Unit (CPU) of the London borough of Hounslow to warn and inform its local population before, during, and after foreseeable emergencies. To accomplish this goal we:

- Identified best practices in emergency communication;
- Examined public response to warning messages;
- Assessed current practices and policies in Hounslow; and,
- Developed a toolkit of warning and informing methods and recommended options suitable for Hounslow.

A combination of background research and interviews with council members, academic experts, and emergency management officials helped us fulfill these objectives.

We interviewed staff from emergency organizations in the United States and the UK, including officials from twelve London boroughs. Interviews focused on the current communication methods these organizations use and compared advantages and disadvantages of the different systems. Archival research and interviews with academic experts described guidelines to follow when constructing an effective warning message. Additionally, we learned how the content and style of the message affect public response. Interviews with staff from Hounslow's CPU, Metropolitan Police Service, and Communications Team helped us understand the current system and identify areas for improvement.

We found three aspects that emergency managers should consider in order to develop an effective emergency communication system. These aspects include the public that will be targeted, the warning message delivered to the public, and the communication system used to deliver this message.

Knowing the community is important when developing an effective warning and informing system. Emergency managers must consider demographic characteristics such as age, social status, cultural and linguistic background, and techno-literacy when identifying the best methods to communicate with the public. The content and style of the warning message strongly affect public response. If the warning is unclear it can lead to a slower response, confusion in the public, and the spread of false information. The message should answer the questions who, what, when, where, and how. Emergency managers should deliver a message that is specific, consistent, accurate, certain, and clear. Additionally, the message must be delivered through multiple channels in order to reach the majority of the population.

We assessed a variety of communication options that are suitable for Hounslow for the preparedness, response, and recovery phases of emergency management. These options included the Council website, social media, mass communication systems, Council magazine, emergency preparedness packages, educational programs, and community and business outreach.

We conducted a focus group with our sponsor, Twm Palmer, to gather feedback about our proposed toolkit of communication options. The criteria we used for the assessment included audience reach, workload, cost, speed, and geo-targeting. These criteria varied by each emergency communication phase. The comments from this discussion guided our recommendations for options that Hounslow should pursue.

Our recommendations focus on improving current methods, implementing new options, and continuing to update communication systems in the future. We suggest that the website should be easily accessible and more user friendly to engage the population. The CPU and Communications Team should utilize Facebook and Twitter in the response and recovery phases of an emergency. A mass communication system should be implemented to communicate with the public. Considering the high cost and maintenance of this system, it is recommended to work

in collaboration with the Hounslow Metropolitan Police or the Hounslow Council. Furthermore, an opt-out system will lead to a greater registration rate.

If the CPU only applied the three methods described above, they would not reach populations without access to such technologies. We recommend pursuing additional options such as the Council magazine, educational programs, business and community outreach, and emergency preparedness packages. Multichannel communication will help increase the amount of audience reached.

A challenge for Hounslow will be to measure the effectiveness of the proposed methods. Although the CPU can collect data on the number of people who received the warning, it is difficult to determine if the public understood and acted on the message. Using surveys sent to the public or taking advantage of the two-way communication of social media, preferably before an emergency occurs, are methods to help measure effectiveness. These assessments will allow further improvements to the Hounslow communication system.

Another challenge is that communication patterns are constantly changing. The CPU needs to stay informed on new trends and upcoming technologies and adapt their communication systems accordingly.

1.0 Introduction

Damages from an emergency can range from casualties to the destruction of the community's infrastructure. For example, the 2003 European heat wave resulted in over 2,000 deaths in the United Kingdom (UK), mostly affecting the elderly, the very young, and the chronically ill (Bhattacharya, 2003). During the 2007 severe flooding in the UK over 55,000 homes and businesses were inundated, of which 35,000 received no early-warning (BBC News, 2007). These calamities could not be prevented, but greater emergency management could have mitigated the resulting damages. Currently, emergency management in the UK is legislated by the Civil Contingencies Act of 2004. This act calls for a top tier team of responders to provide emergency management and help lessen the impact of emergencies. Quick and effective reactions can mean the difference between community disruption and disaster.

Emergency managers have found that communication with the public throughout all phases of an emergency is essential. They have identified three phases: preparedness, response, and recovery. During the preparedness phase, emergency organizations attempt to raise awareness of the possible hazards, safety procedures, and available resources to build a resilient community. Once the emergency strikes, emergency management shifts to the response phase, which consists of using a combination of communication systems to warn and inform the population about the situation and the actions to take. The recovery phase deals with the aftermath of the emergency. At this point, emergency organizations assist the public in returning to normality.

In order to accomplish all these tasks, emergency organizations have begun to use innovative technologies such as mobile notifications and social media in addition to traditional communication systems such as radio, television, telephones, and sirens. Research indicates that one single method will not reach the entire population; therefore, multichannel communication is essential.

The borough of Hounslow has a dynamic, transient, and diverse population. The Contingency Planning Unit is looking to improve their current emergency communication system in order to reach their population more effectively.

The goal of this project is to develop a toolkit of methods for the Hounslow Council to warn and inform its local population before, during, and after foreseeable emergencies. In order to accomplish this goal we have addressed the following:

- Identified best practices in emergency communication;
- Examined public response to warning messages;
- Assessed current practices and policies in the borough of Hounslow; and,
- Developed a toolkit of warning and informing methods and recommended options suitable for Hounslow.

We conducted a series of interviews with key informants, including staff from emergency management organizations in the United States and in the United Kingdom, representatives from mass communication system providers, and academic experts. These helped us gain an understanding of the different factors that come into play when developing a communication system such as the warning message, the public for whom it is intended, and the means of delivery.

2.0 Literature Review

Hazardous events can occur with or without substantial forewarning. Damage can be minimal or catastrophic. Regardless of the tragedy or circumstances, a response from governments and emergency organizations is necessary. A significant aspect of emergency management is communication with the public. The United Kingdom (UK) government believes that a well-informed public is better able to respond to an emergency, minimizing the impact on the community.

2.1 Warning Systems

Responders update their public communication systems as technologies develop. New methods do not necessarily make older methods obsolete, but rather responders add them to the list of possibilities. Mileti and Sorensen conducted over 200 studies of warning systems and response and analyzed options for communication ranging from door-to-door notifications to reverse 911 systems (Mileti & Sorensen, 1990).

Their research indicates that door-to-door warnings tend to be advantageous for small populations or in areas without electricity. People tend to take the warning seriously and respond if officials personally deliver the message. However, door-to-door notifications have many disadvantages such as slow delivery, the difficulty of finding personnel to deliver the message, and not finding people at home (Mileti & Sorensen, 1990). Officials can also distribute the message to public centers such as temples, churches, and community centers, which then disseminate the information to the public. For example, these centers can activate bells to inform the public of an emergency.

Sirens are another warning method. However, unless a siren is designed for one specific type of event, it does not inform the public, but rather alerts them to get more information elsewhere (Besse, Personal Interview, February 19, 2013). Studies show a siren accompanied by a brief automated description of the emergency and the actions to take is more effective than the siren alone (Mileti & Sorensen, 1990). Providing the population with preparedness tips and evacuation plans beforehand, in case of a siren alert, also increases the effectiveness. For example, officials give calendars with emergency tips to residents within a ten-mile radius of the nuclear plants in

and around Massachusetts, USA in case the siren is activated (Besse, Personal Interview, February 19, 2013).

Radio broadcasting is another older method of emergency communication. During the cyclones in Sri Lanka in 1978, radio broadcasting was useful although only 15 percent of the population had electricity and fewer than 60 percent owned radios. It was the only available electronic medium at the time; therefore, the government monopolized it and sent messages across six channels in three languages (Samarajiva, 2005). However, with radio broadcasting alone, people may receive the warning too late or the message may reach those not at risk causing unnecessary chaos (Mileti & Sorensen, 1990).

Research shows that tone alert radio (TAR) devices increased the effectiveness of radios. This device sends a code to radios typically within a 40-mile range. The radios then emit a tone and broadcast a prerecorded message. TAR is advantageous because it is quick and the alert catches people's attention. However, the range is limited and power failures may affect it, similar to any method depending on a central source of power (Mileti & Sorensen, 1990).

Television alerts use a similar idea to TAR. In order to get the public's attention, an emergency alert interrupts programs on multiple channels. Afterwards, information continues to scroll along the bottom of the screen. Graphics make an emergency appear more realistic and may prompt more residents to respond. However, television and radio alerts tend to reach large segments of the population only during prime hours (Mileti & Sorensen, 1990).

The public is more likely to act on a warning if there are multiple communication channels (Besse, Personal Interview, February 19, 2013). Therefore, television and radio broadcasting together tend to be more useful. In 1963, the United States (US) introduced the Emergency Broadcasting System (EBS) allowing the president to warn the public through radio and television (Filcro Media Staffing, 2009). In 1998, the government updated the EBS to the Emergency Alert System (EAS), which added wireless cable systems, satellite digital audio radio service (SDARS) providers, and direct broadcast satellite (DBS) providers to increase public communication. State and local authorities can also send America's Missing: Broadcasting Emergency Response (AMBER) alerts and weather information to specific affected areas

(Federal Communications Commission, 2013). EAS messages are coded and classified based on the type of emergency, speeding up the recognition and retransmission process (Moore, 2009).

Electronic highway boards can display EAS messages regarding topics listed above and road closings and detours. Permanent highway message boards may direct people on how to prepare and respond to emergencies. Billboards can provide emergency evacuation routes. According to the research conducted by Mileti and Sorensen, message repetition tends to enhance public response; therefore, officials should post their message on several signs. However, they indicate that some disadvantages are the necessity to maintain and replace signs and the difficulty of conveying a message in the short time period that a person is passing by (Mileti & Sorensen, 1990).

The automated telephone message system, known as reverse 911, directly targets individuals by sending prerecorded emergency warnings to landlines and registered cell phones. Some systems can hang up existing conversations and block incoming calls to help push the message. Unfortunately, this option is limited because research indicates that on average, few people register their mobile numbers (Mileti & Sorensen, 1990).

The terrorist attacks of September 11, 2001 introduced new technological methods into the field of emergency communication, although the technologies themselves were available since the 1990s. Traditional media played a central role in warning and informing however, recorded videos of the attacks from the public dominated the news and individuals searched the internet for information. “In many ways, 9/11 was the last disaster covered under the older model of crisis communications: Newspapers printed “Extra” editions [and] people turned to television for news” (Haddow, Bullock, & Coppola, 2011).

2.2 Innovative Warning and Communication Methods

Every disaster response since 9/11 has incorporated the use of new technologies for communication. In 2003, during China’s Severe Acute Respiratory Syndrome (SARS) epidemic, the population used text messages to exchange information suppressed by the government. During the Asian tsunami in 2004, blogs and websites provided real time news. In 2005, during London’s transit bombing, people posted images of the disaster in photo-sharing sites such as Flickr. The police used these pictures because they could have contained clues about the

terrorists. Due to insufficient official communication systems during hurricane Katrina in 2005, the population isolated by floodwaters and debris relied on blogs as the primary information-providing tool. Within two weeks of the storm, Internet expert Barbara Palser counted 60 separate online bulletin boards in major portals such as Yahoo! and Craigslist. Online satellite imagery tools such as Google Earth and Google Maps also helped conduct damage assessment (Haddow et al, 2011). Overall, technological advances are transforming how emergency managers view, interact with, and spread information to affected populations during emergencies.

2.2.1 Mass Communication Tools

Social media tools such as Facebook and Twitter and innovative technologies such as mobile text messaging serve as transmitters of vast amounts of information. Through links and statuses, information typed on one computer screen reaches a large number of people via their computers, cell phones, and other mobile technologies in short order. This section presents research concerning Facebook, Twitter, and mobile text messaging, including statistics on their usage, both global and in the UK (Figure 1). These are the most popular mass communication tools used for emergency communication.

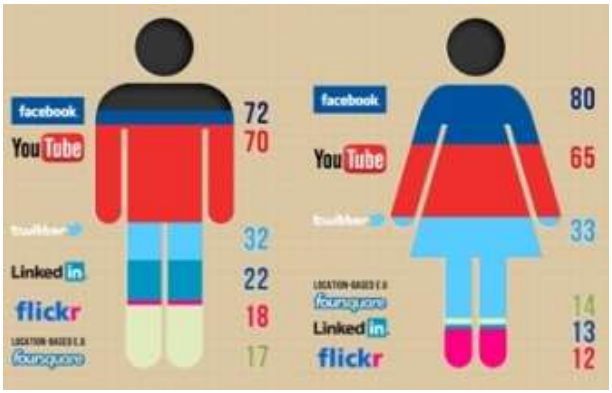

Figure 1 - Percentage of People with an 'Active' Profile on Social Media Platforms in the UK. Retrieved from: http://www.umpf.co.uk/blog/social-media/social-media-usage-in-the-uk-the-findings/

Mobile Text Messaging

Short text messages exchanged between mobile devices, better known as 'Short Message Service' or SMS, have been around for 20 years. SMS messages are up to 160 characters long, including spaces and punctuation. An important aspect of SMS is that, compared to social media

tools, more people of different ages and cultures use it for communication, because it is simple, concise, and compatible with every mobile device. (Kelly, 2012)

Worldwide, over four billion people have access to mobile text messaging and they send around 8.6 trillion messages each year (Naughton, 2012). The population of the UK alone sent 150,651 text messages in 2011 (Ofcom, 2012). This represents an average of 200 text messages per month per person (O'Mahony, 2012).

A downside of SMS compared to other social media tools is that it is a paid service. For this reason, people are increasingly starting to use alternative text messaging applications such as Facebook Chat, WhatsApp, and Apple's iMessage, which allow smartphone users to send all the text messages they want using mobile data instead of paying per message. This has led to a slowdown in the constant growth SMS has had for the last two decades (Kelly, 2012). For example, in the UK there was a two quarterly decline in the total volume of SMS messages sent, decreasing from 39.7 billion in the fourth quarter of 2011 to 39.1 billion in the first quarter of 2012 and 38.5 billion in the second (Ofcom, 2012). However, only 50 percent of all cell phones are smartphones, so SMS is still likely to be highly used in the years to come (Kelly, 2012).

Facebook

Facebook is a social networking site launched in February 2004 that allows users to connect, interact, and exchange information, pictures, and videos with friends, family, and business associates (Conjecture Corporation, 2013). Figure 2 shows Facebook's growth in active users since 2009. As of September 2012, it was the largest of the networking sites with 1.01 billion active users (The Associated Press, 2012).

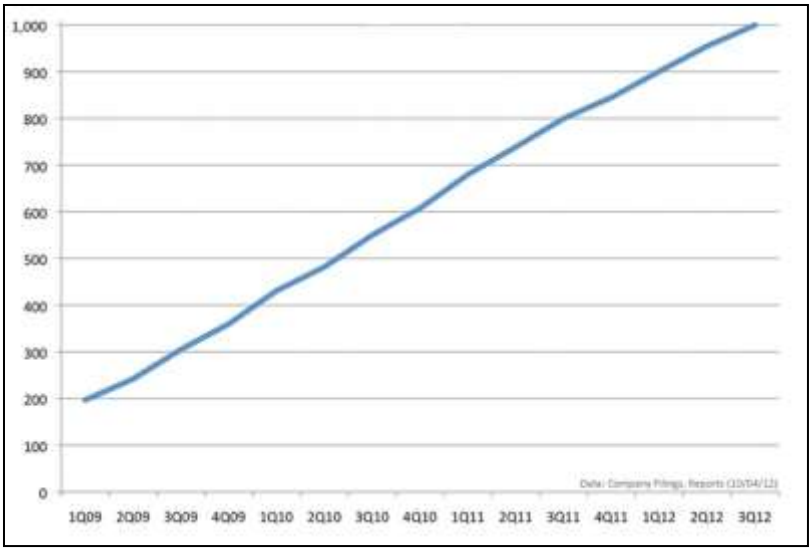

Figure 2 - Facebook Monthly Active Users (in Millions) - Retrieved from: http://wearesocial.net/blog/2012/10/socials-monday-mashup-136/

The UK currently has over 32 million Facebook active users, which corresponds to over 51 percent of their total population and 61 percent of their online population. This brings them seventh in the ranking of number of Facebook users by country (Socialbakers, 2013).

Twitter

Twitter is an online social networking and micro-blogging service launched in March 2006 (Techtarget, 2013). It allows users to send and read text messages of up to 140 characters called 'tweets'. Even though the message is brief, users can see photos, videos, and conversations directly through tweets to get a broader sense of the story behind the message (Twitter, 2013).

By June 2012, Twitter had handled over 400 million tweets per day, which is an increase of 60 million from the month before (Farber, 2012). Figure 3 shows the increase in active Twitter users up until March 2012. Additionally, this service was the fastest-growing social network in 2012 with an increase of 40 percent in active users between the second and fourth quarter of the year ("Twitter was the Fastest-Growing Social Network in 2012", 2013).

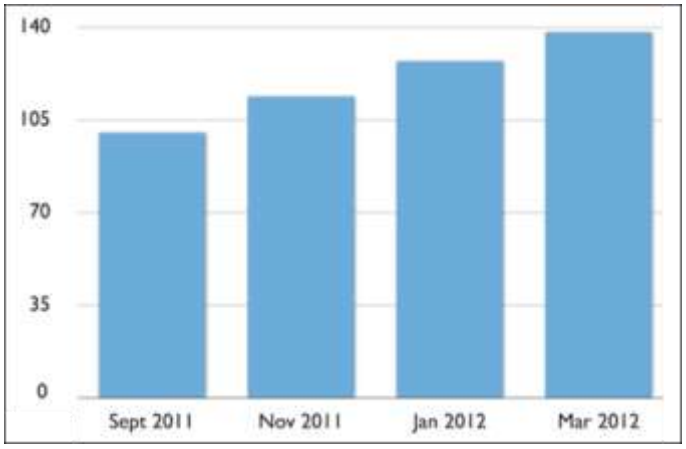

Figure 3 - Twitter's Total Active Users (in Millions). Retrieved from: http://www.mediabistro.com/alltwitter/twitter-active-total-users_b17655

As of May 2012, the UK had 10 million Twitter active users, ranking it fourth among all countries (Arthur, 2012). Statistics released by Twitter Advertising on February 2013 show that 80 percent of UK users access the Twitter platform via a mobile device and mobile users are 40 percent more likely than the average user to access Twitter more than once a day (Chow, 2013).

The table below contains a summary of the number of active users for each of the mass communication tools described (Table 1).

Table 1 – Social Media Active Users (2012)

Tool	Active Users Worldwide (2012)	Active Users UK (2012)
Facebook	1.01 billion	32 million
Twitter	250 million	10 million
SMS	4 billion	N/A

The recent significant increase in the use of these tools makes them important channels for information dissemination that emergency managers should closely look into.

2.2.2 Social Media in Emergency Communication

The increased popularity of social media tools motivates responders to incorporate them in emergency communication for all three phases.

Emergency managers can apply social media to provide preparedness information. “Social networking sites can be used to share emergency plans; blogs can provide household preparedness tips and individual experiences; YouTube can examine protective action

recommendations and how to implement them; Widgets can provide emergency checklists for known disasters; and followers of Twitter can register for emergency alerts" (Knife, 2012).

Shortly after an emergency, during the response phase, those affected can share on-site pictures. Pictures and messages spread quickly, a notion known as 'social milling', through social media sites including Facebook, Twitter, and Flickr before reporters arrive. Officials may observe social milling to adjust emergency responses and public updates. For example, during a tsunami warning in Chile, a geophysicist working for the Pacific Tsunami Warning Center (PTWC) used his personal Twitter account to monitor social media, provide updates, and become a direct contact for major news broadcasters (Sutton, Hansard, & Hewett, 2010).

Social media is also useful during the recovery phase. People have organized volunteer efforts through groups and requested donations for disaster victims. Additional examples include people using Facebook to reconnect with missing people, Twitter to request blood donations or volunteer assistance, and Really Simple Syndication (RSS) feeds to provide emergency room waiting times (Knife, 2012).

Officials should advertise their social media tools during the recovery phase and into the preparation phase. The public's awareness level is high for a time and they may be motivated to become prepared. A case study of the 2010-2011 Queensland floods in Australia exemplifies this trend. The number of 'likes' attributed to the Queensland Police Service Facebook page increased from 17,000 to 100,000 in the first 24 hours after the flash flood (Bird, Ling, & Haynes, 2012). The increase gives a quantitative measure of the number of people searching for information.

Emergency managers tend to use a variety of social media tools to maximize their reach since certain sites are associated with different audiences. For instance, Latino and lower income high school students are more likely to use MySpace (Sydell, 2009), college students and affluent suburbanites are more likely to use Facebook, and younger, higher educated, and affluent people tend to use Twitter most often (Hare, 2009). According to a 2010 Pew Internet study, only 31 percent of adults use social networking sites, online video, text messaging, and portable devices (Lenhart, Purcell, Smith, & Zickuhr, 2010). Therefore, officials must rely on multiple methods to reach more of the population.

There are further weaknesses associated with social media. Misinformation spreads as rapidly as accurate information and it is nearly impossible to delete material once posted on the internet. Websites can go offline when a server crashes. Hackers may manipulate accounts and fake websites or usernames can confuse the public. These risks could cause chaos and uncertainty (Veil, Buehner, & Palenchar 2011). For example, in 2010, a hacker posted tweets from the Indonesian presidential adviser for disaster management's Twitter stating there was a forthcoming tsunami, causing unnecessary panic (Jakarta Globe, 2010).

Organizations are working to overcome this ongoing challenge. For example, the Massachusetts Emergency Management Agency (MEMA) created Facebook, Twitter, and YouTube accounts to distribute correct information and share general emergency tips (Public Safety and Security, 2013). The Queensland Police Services, while monitoring social media traffic, initiated the Twitter hash tag "#mythbusters" to control rumors (Knife, 2012).

Although there are disadvantages, organizations are applying social media more frequently. However, regardless of the channel used, combined research indicates that the entire population will not react the same way to the same message and many factors influence public response.

2.3 Public Response to Warning Messages

Responders must consider public response to emergency warnings when issuing a notification. Through his research on the public's response to hurricanes, Thomas Drabek observed that the initial reaction to an emergency is denial (Drabek, 1999). Michael Lindell made a similar observation, although he considers "disbelief" a more accurate term (Lindell, Personal Interview, April 3, 2013). Both researchers agree that before acting, the individual will need confirmation of the information presented in the warning message. This will lead them to converse with others, look for more information, and search for confirmation of the risk (Mileti, Personal Interview, March 18, 2013). Researchers including Mileti and Drabek conclude that an individual uses a group mentality to process emergency warnings. Interactions with others alter one's perceptions and lead to a lack of immediate consensus, debates, and arguments that significantly slow down the speed of reaction to an emergency warning (Drabek, 1999). However, because people exponentially pass on information through social interactions, they are able to spread the message faster.

"Responses to disaster warnings, like other life conditions, are patterned by invisible webs of constraint" (Drabek, 1999). Some constraints influencing public response include socio-economic status, responsibilities for others, personal beliefs, gender, age and experiences, hazard knowledge, perceptions of risk and the message, and social physical cues (Sutton et al, 2010). Table 2 lists these and other factors in column 1 along with their effect on public response and the level of data supporting the claim in columns 2 and 3, respectively.

Table 2 - Major Factors Covarying with Warning Response. Retrieved from: Sorensen, J. (2000). Hazard Warning Systems: Review of 20 Years of Progress. Nat. Hazards Rev., 1(2), 119–125.

Factor (1)	Response due to factor increase (2)	Level of empirical support (3)
Physical cues	Increases	High
Social cues	Increases	High
Perceived risk	Increases	Moderate
Knowledge of hazard	Increases	High
Experience with hazard	Mixed	High
Education	Increases	High
Family planning	Increases	Low
Fatalistic beliefs	Decreases	Low
Resource level	Increases	Moderate
Family united	Increases	High
Family size	Increases	Moderate
Kin relations (number)	Increases	High
Community involvement	Increases	High
Ethnic group member	Decreases	High
Age	Mixed	High
Socioeconomic status	Increases	High
Being female versus male	Increases	Moderate
Having children	Increases	Moderate
Channel: Electronic	Mixed	Low
Media	Mixed	Low
Siren	Decreases	Low
Personal warning versus impersonal	Increases	High
Proximity to threat	Increases	Low
Message specificity	Increases	High
Number of channels	Increases	Low
Frequency	Increases	High
Message consistency	Increases	High
Message certainty	Increases	High
Source credibility	Decreases	High
Fear of looting	Decreases	Moderate
Time to impact	Decreases	Moderate
Source familiarity	Increases	High

These factors can be used to statistically model a social process of the sequence of events that occurs in the human mind while responding to an emergency warning (Mileti, Personal Interview, March 18, 2013). For instance, through his research, Drabek observed that males might consider it unmanly to evacuate and therefore may respond more slowly than females. He

also concluded that younger people tend to respond quickly to warnings due to their lack of knowledge and greater feeling of vulnerability in a disaster. In addition, Drabek and Mileti observed that elderly people respond slowly due to their "seen it all" mentality. Both researchers also agreed on the observation that ethnic minorities and those with a lower socio-economic status may mistrust law enforcement personnel and their official messages, leading to a lack of response to emergencies. In addition, people with a lower socio-economic status might have a delayed response due to factors such as social isolation, technological deficiency, and vulnerable living conditions (Drabek, 1999, Mileti, Personal Interview, March 18, 2013).

Public response plays a significant role in the creation of the warning message because different social groups do not perceive the message in the same way. A high quality message decreases the influence of the factors and increases the ability to manage public response (Mileti, Personal Interview, March 18, 2013).

2.4 Characteristics of an Effective Warning Message

Academic research shows that different factors determine the effectiveness of a warning message. According to Sorensen, content and style are the most important aspects regardless of the choice of technology used for dissemination. Emergency responders should carefully construct warning messages to provide specificity, consistency, accuracy, certainty, and clarity (Sorensen, 2000). Mileti supports this claim by indicating that a message that increases the public's response would give clear instructions on what to do and when to do it, the geographical locations of those affected, who needs to evacuate, and the message source (Mileti, Personal Interview, March 18, 2013). Moreover, providing the public with cues such as maps showing the pathway of the storm or images of destruction allows the public to truly assess the severity of the situation and take the warning message seriously (Mileti & Sorensen, 1995).

A study of public response to warning of impending emergencies by Mileti and Peek indicates that officials should deliver the information in a simple language that the majority of the population can understand. The information should also be consistent within the message and across different messages to avoid confusion. The warning message needs to be convincing and, even when some specific information about the emergency is not available, the style used to write it should always be precise (Mileti & Peek, 2000).

The use of credible sources to deliver the message enhances its effectiveness (Mileti & Sorensen, 1995). The most credible source tends to vary for different kinds of populations. For instance, in the US the most credible source is firefighters for the general population and the Red Cross more specifically for lower socioeconomic groups. Therefore, the voice of the message should be a combination of sources to increase its credibility (Mileti, Personal Interview, March 18, 2013).

In addition to the content and style, successful emergency warning systems should focus on the repetition of the message. Emergency managers should use various communication technologies to spread the same message as well as simply repeat the message several times through the same channel. This will ensure that they convey the significance of the message to the majority of the population (Mileti, Personal Interview, March 18, 2013). Research concerning the older EBS indicated that officials should repeat the messages every 15 minutes. This measure will help capture the public's attention and reduce the spread of rumors. However, research concerning new technologies shows that the frequency of the updates is more important than the repetition of the same message. Experts have learned that officials should send updates when the content of the warning message has substantially changed (Mileti & Sorensen, 1995).

It is important that officials release a clear and reliable message; otherwise, people will look for information elsewhere in order to fill in the gaps. These other sources may provide inaccurate or misleading information and subsequently cause an inappropriate response to the emergency.

2.5 Emergency Management in the United Kingdom

The Civil Contingencies Act of the United Kingdom (UK), defines an emergency as "an event or situation which threatens serious damage to human welfare in a place in the UK, the environment of a place in the UK, or war or terrorism which threatens serious damage to the security of the UK" ("London Community Risk Register", 2010).

2.5.1 The Civil Contingencies Act

The Civil Contingencies Act (CCA) provides the framework for emergency planning and response throughout the UK at both national and regional levels. Subsequent to the fuel crisis and severe flooding in 2000 and the outbreak of foot and mouth disease in 2001, the government established that the existing legislation for emergency planning was no longer adequate for

modern civil protection efforts. As a response, they established the CCA in 2004 ("Civil Contingencies Act 2004", 2012). The act is divided into two parts dealing with local arrangements for civil protection and the use of emergency powers.

The CCA establishes a framework of roles and responsibilities for local responders. These local responders are divided in two categories depending on their involvement. Category 1 responders include the Police, Ambulance and Health Services, the London Fire Brigade, the Environment Agency, Local Authorities, and the Maritime & Coastguard Agency. These responders must assess the risk of the emergency, implement emergency plans, share information and co-operate with other local responders, communicate information about civil protection matters to the public, and warn, inform, and advise them in the case of an emergency ("Civil Contingencies Act 2004", 2012).

Category 2 responders cooperate with those in Category 1. They are required to get fully involved with incidents that affect their sector. Category 2 responders include organizations such as the Highways Agency, the Port of London Authority, transport companies, and utilities ("Civil Contingencies Act 2004", 2012).

The CCA also establishes a framework for the promulgation and implementation of special temporary legislation to deal with the most serious of emergencies, although these powers are rarely used and are considered an instrument of last resort ("London Community Risk Register", 2010).

2.5.2 National Risk Register

Catastrophic emergencies are rare in the UK. Nevertheless, it is important to increase awareness about the potential risks the UK could face and encourage individuals and organizations to be prepared. With this goal in mind, the government produced the "National Risk Register of Civil Emergencies" (NRR), which was published in 2008 and revised in 2012. The NRR is a document that "provides updated information about the type of civil emergency that people in the UK could face over the next five years" ("National Risk Register of Civil Emergencies", 2012).

In the revised version of the NRR the government considered pandemic influenza, coastal flooding, catastrophic terrorist attacks, severe effusive (gas-rich) volcanic eruptions, and severe space weather as the highest priority risks, taking into account both likelihood and impact (Figure 4).

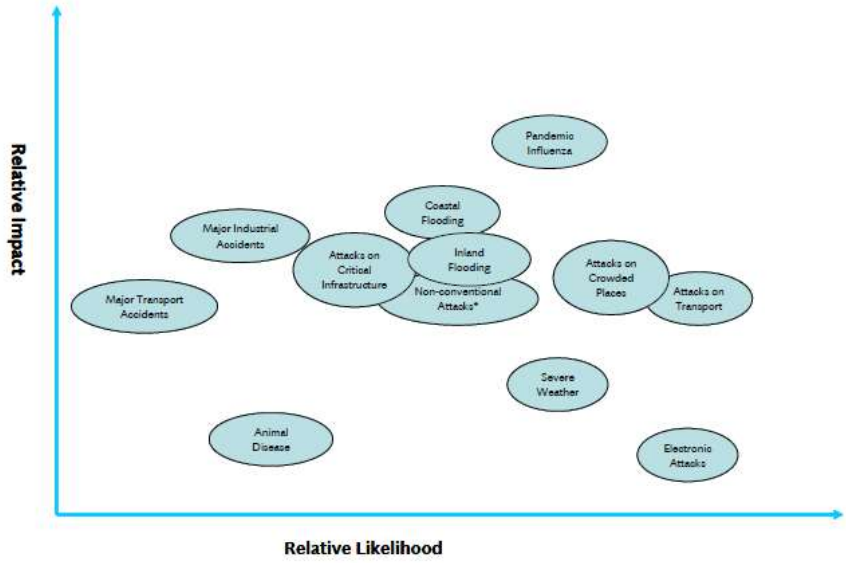

Figure 4 – Relative Impact and Likelihood of High Consequence Risks facing the UK.
Retrieved from: http://www.london-fire.gov.uk/Documents/LondonCommunityRiskRegister.pdf

2.5.3 Hounslow Risk Register

The Hounslow Resilience Forum has the responsibility to identify local risks that could cause an emergency and evaluate the possible consequences. They gather all this information to produce the Hounslow Risk Register (HRR) as a response to the CCA. This document aids in preparing, responding, and recovering from emergencies. The HRR does not cover threats (i.e. terrorist attacks), only hazards where the ability to predict or forecast exists. This does not mean that the former are not important. However, because of possible misuse, the information on how to deal with terrorism is not published (Contingency Planning Unit, 2013).

The register covers all types of hazards and the controls that are in place to protect the community. The hazards with the highest risks on the HRR include severe weather such as flooding and heavy snow, human health such as pandemic flu, and loss of utilities such as telecommunication failures (Contingency Planning Unit, 2013).

2.6 Emergency Management in Hounslow

The River Thames on the south, River Cane on the east, and River Brent on the west surround Hounslow, making flooding a constant concern. Of all of the hazards that threaten the borough, riverine flooding and surface water flooding are the most prevalent ("London Borough of Hounslow Strategic Flood Risk Assessment", 2007).

Other hazards identified in Hounslow include large industrial sites, high-pressure pipelines, and risks of aircraft accidents since the borough is under the flight path of the Heathrow airport. The Council created various maps to identify the most vulnerable areas to hazards. A map created in 2008 identifies the areas with the highest risk, shown in darker color, to be in the Chiswick Riverside Ward, Chiswick Homefields Ward, Syon Ward, Hounslow South Ward, Isleworth Ward, Bedfont Ward, and parts of the Feltham West Ward, Hanworth Park Ward, and Hanworth Ward (Figure 5) ("London Borough of Hounslow Strategic Flood Risk Assessment", 2007). Understanding the vulnerability and hazard risks of the borough is crucial in emergency planning. The vulnerable groups that appear to be at risk can be educated about proper behaviors during an emergency (Bell, McFarland, Pole, & Innerd, 2008).

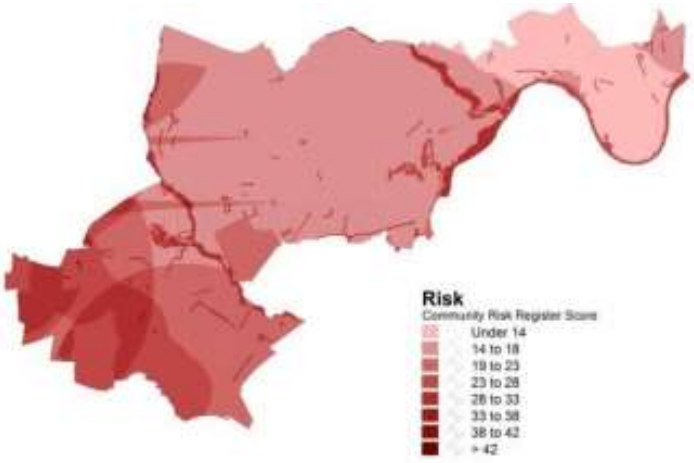

Figure 5 - London Borough of Hounslow Risk Map. Retrieved from: http://www.preventionweb.net/files/7591_CLIMATECHANGEANDDISASTERIMPACTREDUCTION1.pdf

2.6.1 Distinctions in Vulnerabilities in Hounslow

Vulnerable groups are of special concern to emergency planners. Based on the social, health, or environmental aspects of the population, they must implement different communication strategies during an emergency in order to reach the entire population.

Social vulnerability denotes populations that do not speak the local language, lack a certain degree of education, lack access to transport services, lack social support services, are located in

an area of extreme high or low density, and those who are unaware of local hazards due to migration (Bell et al, 2008). For example, in Hounslow 35 percent of the population is non-white (Figure 6) and over 140 languages are spoken by the residents. The borough has the fourth largest population of Indians in London, with over 48 thousand Indians (Office for National Statistics, 2012).

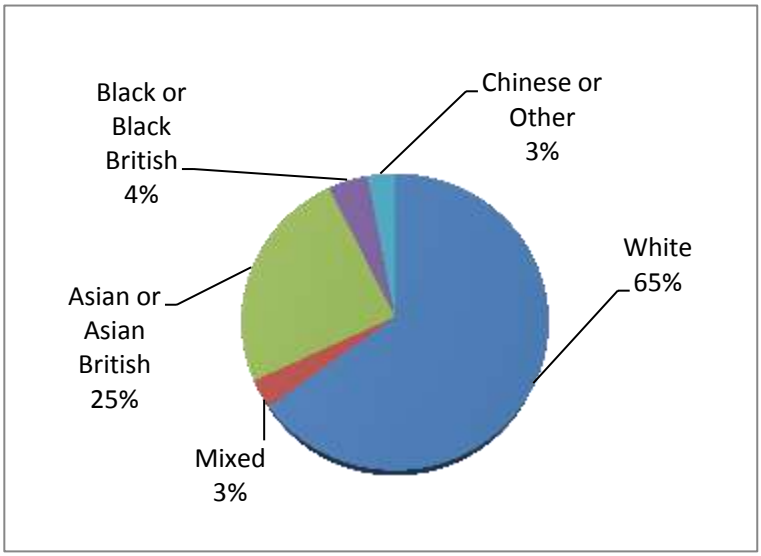

Figure 6 - Ethnicity in Hounslow. Retrieved from: http://www.hounslow.gov.uk/all_people_ethnic_group_hounslow_borough-2001census.pdf

People living in areas with increased likelihood of flooding or other environmental disasters are considered environmentally vulnerable. In Hounslow, flooding is so prevalent that the borough is divided into four flood risk zones in order to better identify the areas of highest flood probability (Appendix B) ("London Borough of Hounslow Strategic Flood Risk Assessment", 2007). Emergency planners must take special preparedness measures to protect those areas and the populations within them.

Different areas of the borough also have different poverty levels, which responders should consider when informing the population about emergencies. The areas where the population is poorer might not have access to certain technologies as easily as the areas with a wealthier population. In 2007, the Council created a multiple deprivation indices map using socioeconomic data to indicate areas with the highest and lowest poverty (Figure 7). Highest areas of deprivation appear darker on the map.

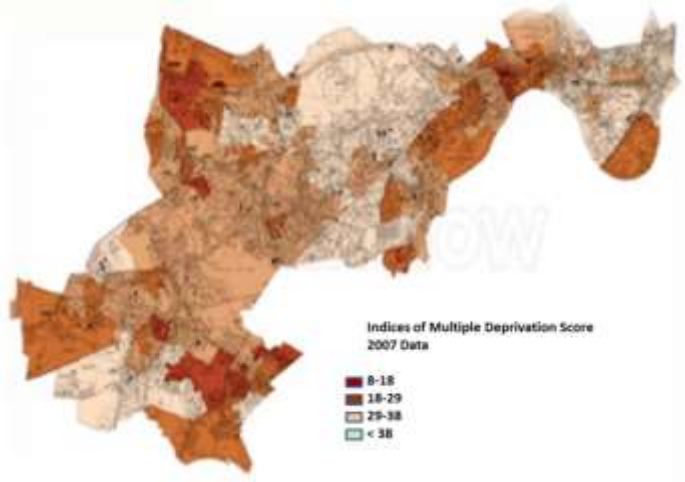

Figure 7 –Indices of Multiple Deprivation 2007. Retrieved from: http://www.preventionweb.net/files/7591_CLIMATECHANGEANDDISASTERIMPACTREDUCTION1.pdf

Health vulnerability denotes populations with long-term illnesses, high proportion of disabled people, lack of health facilities, or high populations of the elderly (Bell et al, 2008). Although 64 percent of the population in Hounslow is between the ages of 20 and 64, there are still a lot of elderly and children as well as people with disabilities (GLA Intelligence Unit, 2012). In 2008, a vulnerability map of Hounslow was created based on different indicators such as population with a limiting long-term illness, population seeking employment, multiple deprivation, population density, and age which includes children under the age of 5 and adults over 70 years old (Figure 8). The darker areas of the map mean that a few of the indicators ranked highly in the area, making it more vulnerable.

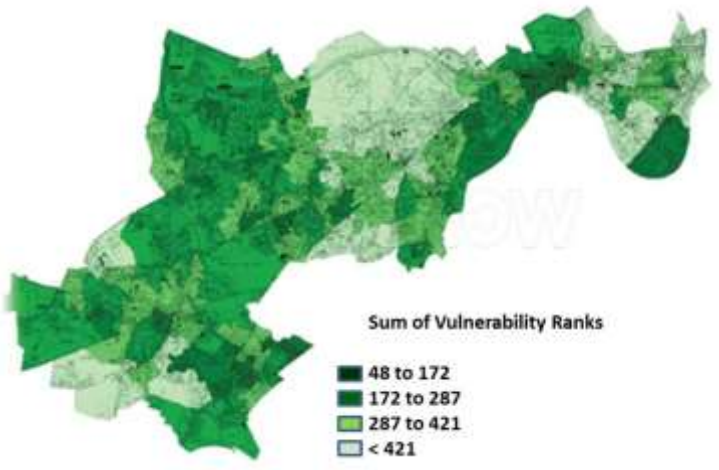

Figure 8 - Emergency Planning Vulnerability Map. Retrieved from: http://www.preventionweb.net/files/7591_CLIMATECHANGEANDDISASTERIMPACTREDUCTION1.pdf

2.6.2 Emergency Communication in Hounslow

According to Hounslow's Major Emergency Plan, public information is a coordinated process between different organizations including the Corporate Communications Unit and the Borough Emergency Controller. The roles of the Borough Emergency Controller include dealing with information made available to the public, media, and the staff. They "oversee information given to the news media and deal with all relating to the Council's response to the emergency". In cooperation with the Information and Advice Coordinator and the Corporate Communications Manager, they make known information about the emergency to everyone and approve press releases ("Major Emergency Plan", 2007).

Hounslow has multiple channels of information for the public before, during, and after an emergency. These channels include Hounslow's council website, Twitter account, Facebook account, the Hounslow Risk Register, information phone line, and a drop-in service.

The council uses their website, Twitter account, and Facebook account during all three phases of an emergency. The recently updated Hounslow emergency planning website contains information about emergencies that are likely to occur in Hounslow such as storms, flooding, severe weather, flu, and fire. It also details the role of the borough in emergency response and their cooperation with the Metropolitan Police Service, London Fire Brigade, and London Ambulance Service. Other pages state what the public should do to prepare their families and homes and show links to other emergency resources. During an emergency, the Council posts links on the front-page of their website that leads residents to more information and tips of what to do. The Twitter and Facebook accounts are available to post tips and links at any time and spread information. For instance, during the 2011 riots, people used Twitter to ask if certain things were true or not. The Council used their account to monitor and respond to these inquiries (Amarasekara, Personal Interview, April 9, 2013). During the time between emergencies, the Facebook page provides information such as local events, job openings at schools, and weather updates. The Twitter feed asks for community input and interacts with the community directly.

The Risk Register provides a detailed list of possible emergencies for Hounslow. The Council makes this information public so people can learn which emergencies are most likely for their

area of residence. This preparation occurs in the before phase of an emergency and creates a better-informed public.

The Hounslow government has information lines that a resident can call to listen to an automated message. Members of the Contingency Planning Unit (CPU) set up these automated messages, which depend on the situation at hand. These lines are open during and after an emergency. On the scene of an emergency, the CPU hands out information cards to the affected population which list the information line number they can call. There are also information lines for business recovery staff during office hours and another line for on-call staff outside regular office hours.

Another option for residents to receive information after an emergency is a drop-in service located at the Civic Centre, the base of the Hounslow government, or possibly at an alternate location depending on the circumstances.

Hounslow has no public mass notification system, but there is a text message system for senior managers. These people are responsible for reporting in, if necessary, when an emergency occurs. A member of the CPU sends them the message, limited to 160 characters, from a mobile device or a web browser. This message states that an event has occurred, the time of the event, and includes an emergency information phone number.

The borough of Hounslow, because of its socio-demographic, economic, and geographic characteristics faces substantial risks and is interested in looking at better ways to communicate with its population before, during, and after an emergency. There are many options available, but not all are suitable for the borough based on its risks, needs, and capabilities.

3.0 Methodology

The goal of this project was to develop a toolkit of methods for Hounslow to effectively and efficiently warn and inform the local population before, during, and after foreseeable emergencies. To accomplish this goal we:

- Identified best practices in emergency communication;
- Examined public response to warning messages;
- Assessed current practices and policies in the borough of Hounslow; and,
- Developed a toolkit of warning and informing methods and recommended options suitable for Hounslow.

Figure 9 shows an overview of our goal, related objectives, and associated tasks for each objective.

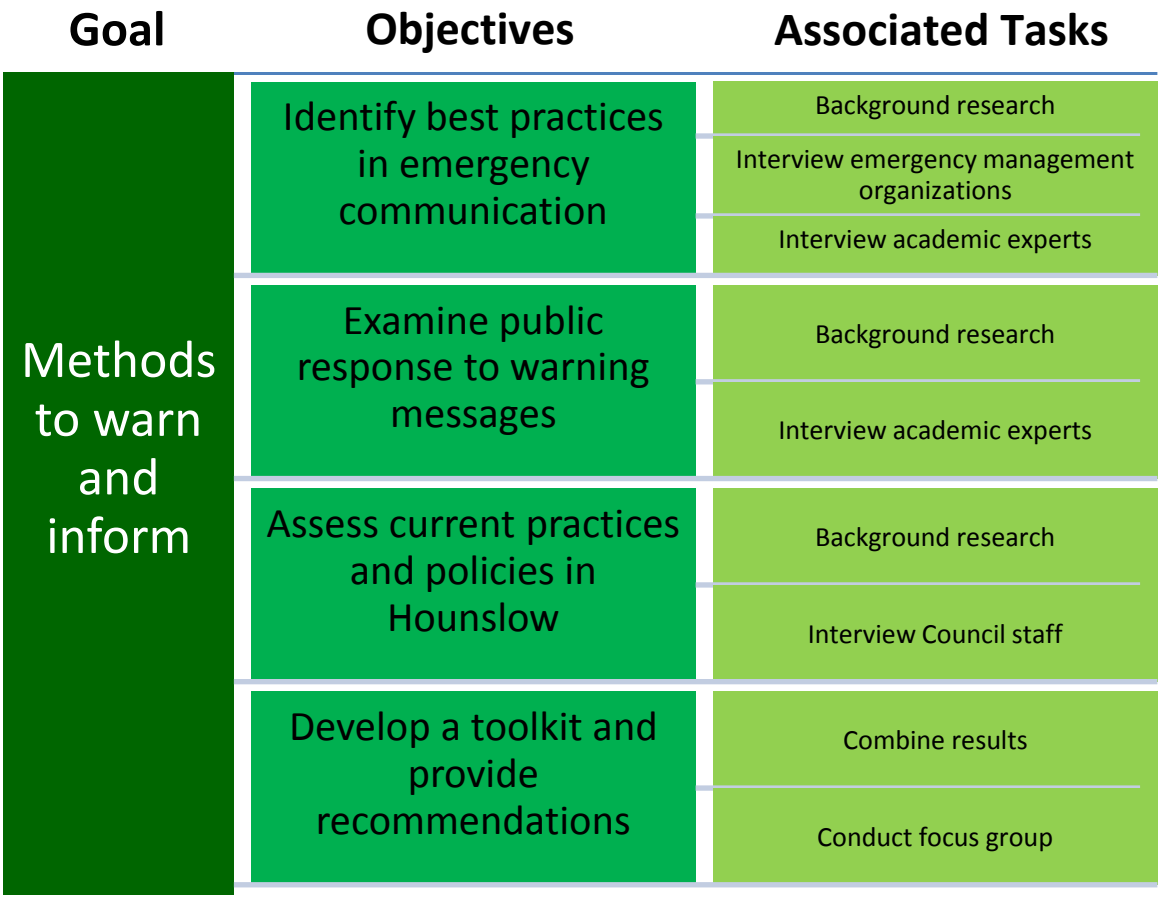

Figure 9 - Project Overview

This project took place between January 10, 2013 and April 26, 2013. Building on the background research conducted throughout the semester, we interviewed Hounslow Council staff, academic experts, and emergency management staff from United States (US) and United Kingdom (UK) organizations. The results were analyzed and a preliminary toolkit was presented and discussed in a focus group with Twm Palmer, our liaison in the Contingency Planning Unit (CPU). Revisions to the toolkit were made accordingly.

The general process we used for interviews consisted of three phases: identification of contacts, scheduling, and interviewing. We identified possible interviewees through academic journals, articles, and websites and Twm Palmer provided additional contacts. We used a snowball sampling technique in which we asked each interviewee to suggest other key informants.

We gathered background information on each of the interviewee's role within their organization before contact. Then we e-mailed them requesting an interview and scheduled a meeting. A second email confirmed the interview and, if requested, provided questions to be asked during the meeting. Interview scripts were developed based on the background information, previous interviews, and feedback from our sponsor regarding his particular areas of interest.

We conducted interviews in person and through phone conferences. A designated team member took minutes with the permission of the interviewee. During the revision of our final report, we sent the interviewees a copy of the sections in which they are referenced or quoted for their approval.

3.1 Identify Best Practices in Emergency Communication

We evaluated current emergency communication practices used worldwide. This required examining the known advantages and disadvantages of traditional and innovative communication methods used during the preparedness, response, and recovery phases of an emergency. In addition, we investigated the characteristics of an effective warning message.

The literature review provided an overview of the current practices. In-depth interviews with staff from US and London emergency management organizations, representatives from mass communication system providers, and academic experts supplemented the initial research.

All the interviews conducted for the completion of this objective followed the general process described above. Face-to-face interviews were preferred because they allowed for a more engaging conversation. However, for convenience of the interviewee, we conducted most interviews by phone. We used a script as a guide (Appendix D), which we slightly altered for each interview based on the interviewee's background and our experience from previous interviews.

3.1.1 US Emergency Management Staff

We contacted representatives from US government agencies and organizations known for their extensive experience handling large-scale public emergencies. They included the Federal Emergency Management Agency (FEMA), the Massachusetts Emergency Management Agency (MEMA), Worcester Emergency Management, and the Springfield Office of Emergency Preparedness. Contact information was obtained from each organization's website. We also reached out to Worcester Polytechnic Institute (WPI) even though they deal with emergencies of a smaller scale. Below is the list of emergency management staff we interviewed:

- **Christopher Besse** – Preparedness Coordinator, MEMA
- **Philip Clay** – Dean of Students, WPI
- **David Clemons** – Director, Worcester Emergency Management
- **Robert Hassett** – Director, Springfield Office of Emergency Preparedness
- **Jason Lindesmith** – Social Media Lead, FEMA

The interviews gave us a better perspective on the actions emergency managers take and the warning message they use to warn and inform the population before, during, and after an emergency. We also gained an understanding of how these organizations reach out to various social vulnerable groups, specifically focusing on the young, elderly, and ethnically diverse.

3.1.2 London Emergency Management Staff

Twm Palmer provided the contact details of Emergency Planning Unit officials from all the London boroughs. Below is the list of officers we interviewed:

- **Stephen Arundell** – Senior Emergency Planning Officer, Borough of Redbridge
- **Anna Bastow** – Emergency Planning Officer, Borough of Croydon

- **John Brown** – Head of Emergency Planning, Borough of Lewisham
- **Alan Clark** – Emergency Planning & Business Continuity Manager, Borough of Havering
- **Jo Couzens** – Civil Contingencies Planning Officer, Borough of Lambeth
- **Steve Crawley & Andrea White** – Emergency Planning Unit Officers, Borough of Tower Hamlets
- **Keith Fleming** – Emergency Management Officer, Borough of Camden
- **Andrew Meek** – Emergency Planning and Business Continuity Manager, Borough of Haringey
- **Tony Plowright** – Emergency Planning Manager, Borough of Bexley
- **Mike Price** – Civil Protection Manager , Borough of Hillingdon
- **Jyoti Sapkota** – Emergency Planning Officer, Royal Borough of Kingston
- **Kate Solomon**- Emergency Planning Manager, Borough of Barnet

Through these interviews, we gained an understanding about their organization's current and previous methods of warning and informing, the actions they take to reach social vulnerable groups, and any difficulties they notice about their methods.

3.1.3 Mass Communication System Provider Representatives

With the research conducted, we determined that an option for Hounslow was a Short Message Service (SMS) mass communication system. Therefore, we contacted London mass communication system providers that list SMS as one of their tools. Twm Palmer provided the initial contact and we conducted conference calls with their representatives, listed below:

- **Scott Chenery** – Everbridge
- **Natalie Cooper** – Vocal
- **Laura Meadows** – HTK Horizon

These interviews provided us with a better grasp of what different SMS systems in the UK entail and the features they have to offer. We also gained an understanding of how these features can be used to reach social vulnerable groups.

3.1.4 Academic Experts

We contacted academic experts who have made significant contributions to the field of emergency communication. Initial contacts were obtained through our advisor Dominic Golding, followed by recommendations from the interviewees.

- **Dennis Mileti** – Professor Emeritus at the University of Colorado at Boulder
- **John Sorensen & Barbara Vogt Sorensen** – Research Professional at Oak Ridge National Laboratory & Sociologist
- **Jeannette Sutton** – Disaster Sociologist
- **Michael Lindell** – Psychologist and Expert in Emergency Management

The interviewees gave us insight into emergency communication and their opinions on how to warn and inform the public.

3.2 Examine Public Response to Warning Messages

To complete this objective we examined literature related to the sociology of public response during emergencies and interviewed academic experts, identical to those listed above in objective 3.1. The interview script (Appendix D) consisted of questions about differences in public response to emergencies.

Through the fulfillment of this objective, we learned about how to approach the public during an emergency. Through this research, we identified the various factors that affect people's perceptions of an emergency and their response to the warning message. Factors include demographic differences such as age, ethnicity, and social status, as well as the nature of the emergency and the message delivered. Additionally, we looked into good practices that emergency managers should follow when constructing and delivering a warning message in order to increase its effectiveness.

3.3 Assess Current Practices and Policies in Hounslow

We assessed the current practices for warning and informing in Hounslow by using a combination of archival research and interviews. We reviewed emergency strategies and policy

documents such as the Civil Contingencies Act (CCA), Hounslow Risk Register (HRR), and documents explaining the procedure of using Hounslow's internal SMS system.

We participated in informal meetings with the CPU staff including Twm Palmer, Ben Axelsen, and Richard Davill. The CPU staff explained the different options they have to communicate with the public and the procedures followed during emergencies. They also highlighted documents with policies relevant to Hounslow's emergency management.

Hounslow's Communications Team and the Metropolitan Police Service are highly involved in the emergency communication process. The Communications Team is responsible for all the messages and advertisements coming from the Council, including emergency information. We interviewed Jini Amarasekara, Hounslow's Internal and External Communications Manager, to understand their partnership with the CPU, the process followed when constructing and delivering a message, and their current communication systems.

The Metropolitan Police Service usually takes the lead in warning and informing the population during an emergency. We interviewed Rob Weir, an officer of the Metropolitan Police branch in Hounslow, to understand their collaboration with the CPU and identify their public communication tools.

Both interviews followed the general interview process described above. We used interview scripts for the Communications Team interview (Appendix E) and the Metropolitan Police interview (Appendix F) as general guidelines.

3.4 Develop a Toolkit of Warning and Informing Methods and Recommend Options Suitable for Hounslow

Data gathered from our background research and interviews from the three previous objectives determined the toolkit. The study of emergency communication systems already implemented worldwide and in London boroughs provided us with public communication options. The public response analysis helped create a guideline to follow when constructing an effective warning message. The assessment of current emergency communication practices in Hounslow helped us understand what needs to be addressed.

We provided an analysis of various options Hounslow could use for public communication during the preparedness, response, and recovery phases of an emergency. This included advantages and disadvantages of each method and their effects on public response.

A focus group with Twm Palmer was conducted to assess the toolkit (Appendix G). This focus group helped us collect feedback and suggestions on the desirability and feasibility of the proposed options and gave us the capability to provide recommendations specific to Hounslow.

4.0 Findings and Analysis

Academic research indicates that multichannel communication is essential in order to achieve effective emergency management. No single option represents the ultimate solution in emergency communication. The public is diverse in itself, and using one method would not reach the entire population. This is why emergency organizations should use a toolkit of different methods to reach the majority of the population during the preparedness, response, and recovery phases.

Through our research, we identified three aspects that emergency organizations should consider in order to develop an effective emergency communication system. These aspects include the public that will be targeted, the warning message that is delivered to the public, and the communication system used to deliver this message.

4.1 The Public

In order to develop an effective warning and informing system, emergency services personnel need to know their community (Lindell, Personal Interview, April 3, 2013). Understanding demographic differences such as age, social status, cultural and linguistic background, and techno-literacy is essential.

The methods used to communicate with the population during emergencies need to be relevant to the community in question. Hounslow, as many other London boroughs, is very diverse. For instance, it has the fourth largest population of Indians in London (Office for National Statistics, 2012), residents speak over 140 languages (EMMA, 2013), and it has a high transient population due to its proximity to Heathrow airport ("Housing Strategy: 2010-2014", 2010). Emergency managers should make sure all these groups are considered when choosing how to communicate a message.

Not everyone will receive emergency information through the same channel. For instance, older populations are less likely to use modern technologies such as social media, mobile text messaging, and websites (Sutton et al, 2010). Children tend to rely more on their parents or representatives telling them what happened and what to do. Non-English speakers may not

understand the message if it is not translated or written in a simple fashion (Sorensen, Personal Interview, March 26, 2013).

Each method has its limitations on the number of people and the demographic groups it reaches, reinforcing the conclusion that multiple methods needs to be used in order to reach the majority of the population.

4.2 The Message

Through our research, we found that an effective warning message is important for a successful public response. The information must be specific, consistent, accurate, certain, and clear (Sorensen, 2000). Depending on the situation, the content of the message will vary. However, the message is most effective if it answers the questions who, what, when, where, and how.

4.2.1 Who

Emergency managers must provide the name or agency sending the warning message. They must avoid acronyms, unless there is confidence that all people receiving the message will understand them (Australian Government, 2008).

A combination of sources increases credibility (Mileti, Personal Interview, March 18, 2013). This does not mean different organizations should send multiple and different messages. Either a panel of agencies should deliver a single message several times or each agency should send the same message individually (Mileti & Sorensen, 1990). However, if the emergency is not in the organization's area of expertise, it might not make sense for them to send the message (Australia Government, 2008). For example, the Highways Agency in London can send information on road closures, while the National Health Service can do it for release of toxic chemicals.

4.2.2 What and Why

The warning message should indicate the type of hazard and how it is putting the public at risk (Lindell, Personal Interview, April 3, 2013). For example "… thunderstorm capable of damaging houses making traveling dangerous" (Australian Government, 2008). If a warning message is vague, people will give different interpretation to the emergency and respond accordingly (Mileti & Peek, 2000).

The Australian Government developed a document on how to construct warning messages, in which they provide a list of good words to use when describing a hazard. According to the Australian Government, it is more effective to use words such as "you" and "home" rather than "people" and "properties". Additionally, they suggest that words such as "killed" and "death" are too strong .An alternative way to communicate this type of warning could be "there is risk to lives and homes" (Australian Government, 2008).

4.2.3 Where

Warning messages must provide the location of an emergency in simple language. This helps identify who is at risk and who is not (Mileti & Peek, 2000). According to the Australian Government, explaining where the hazard applies is one of the hardest aspects of constructing a warning message. "There is no single way of describing a geographical area that will always work for everyone" (Australian Government, 2008).

In their document on how to construct a warning message, the Australian Government highlights the following considerations: many people cannot orient themselves through compass directions; many people are not able to estimate distances accurately; and extremely well known landmarks can help identify specific areas (Australian Government, 2008).

4.2.4 When

Emergency managers must indicate the timeframe of the disaster, including when it is expected to occur and when the population must take action. For example, "The snow storm will not hit until 3 pm, but to be on the safe side you should be off the streets by 2 pm" (Mileti & Sorensen, 1990).

When warning the public about an emergency that will occur later, emergency managers should use the time of day, for example, "between 11 am and 5 pm" or "before 4 pm". However, if the emergency will occur in is less than an hour, it is better to use relative time, such as "anytime within 20 minutes". In this case, it is important to include when the message was delivered (Australian Government, 2008).

4.2.5 How

A warning message must clearly indicate the protective actions the public must take. Just saying "evacuate" or "shelter-in-place" is not sufficient. Emergency managers should not assume certain things are obvious and must provide detailed information on how and why to take protective action (Mileti, Personal Interview, March 18, 2013). For example, "create a water supply using buckets, troughs and baths in case it is needed to put out spot fires" (Australian Government, 2008). Additionally, the message should specify, if possible, means by which people can get more information, including a website address and/or telephone number.

The table below presents a checklist that emergency managers could use to confirm that all the necessary information is included in a warning message (Table 3).

Table 3 - Good Practices for Emergency Message Construction

Message Creation Checklist		
Question	**Answer**	**Check if included**
WHO?	Source sending out the warning	
WHAT?	Hazard information	
WHY?	Reasons for being a hazard	
WHERE?	Areas/Populations at risk	
WHEN?	Timeframe of event	
HOW?	Appropriate response	
	Receive more information	

If this information is included in a message, the public will likely respond positively to the emergency. Clear information on what is happening minimizes rumors and false conclusions. Additionally, it is useful to have a language translation guide such as the British Red Cross Language Booklet, which allows message translation in over 30 languages (Clark, Personal Interview, April 9, 2013).

4.3 Warning and Informing Options

We have seven emergency communication options for Hounslow to potentially improve or implement (Table 4). The seven options and a brief description of their use are listed below.

Table 4 - Communication Options and Descriptions

Method	Description
Educational Programs	Teach the community about emergencies
Council Magazine	Sent out quarterly containing local borough information
Preparedness Packages	Contains emergency tips and contact numbers in a convenient fold-out card or book
Council Website	Main source of local information
Mass Communication	Sends out messages through text and/or email
Social Media	Online network to post information, links, and/or pictures
Community Outreach	Helps disseminate information to businesses and community centers

The following sections list each phase of an emergency and its respective communication options. We assess each option by ranking them low, medium, or high based on criteria relative to the emergency phase. The values are not definite, but rather relative based on comparing methods to each other.

4.3.1 Preparedness Phase

The preparedness phase refers to pre-event activities and mitigation efforts to develop operational capabilities and effective responses to an emergency (County of Los Angeles, 2013). During this phase, the goal of the Hounslow Council is to build a resilient community. We have identified four communication channels that they can implement or improve upon in order to achieve this goal. We assess and compare these methods based on three criteria: the audience reached, workload, and cost (Table 5).

Table 5 - Assessment of Communication Option for the Preparedness Phase of an Emergency

Methods		Assessment Criteria		
		Reach	Workload	Cost
	Website	M-H	L	L
	Magazine	H	L	L
	Education	M	H	M
	Packages	H	H	H
		L= Low	M= Medium	H= High

An ideal emergency communication channel would reach the entire population, require minimum workload and maintenance, and have a minimal cost.

4.3.1.1 Council Website

The Council website is the main channel emergency managers use to disseminate preparedness information and it is available to everyone in the borough. However, the information posted does not directly reach the individuals; they need to take the initiative to visit the site.

If responders do not use this method in combination with other tools, they would be ignoring people who do not use or do not have access to the internet, including social vulnerable groups such as the elderly and the very poor (Meek, Personal Interview, April 2, 2013). Even the people who are constantly in the internet might not receive the information through this channel because they would not take the initiative to check the Council website.

For most boroughs, the links that lead viewers towards the emergency planning site are not obvious or easy to find, decreasing audience reach. Twenty-nine out of the 33 boroughs in London require viewers to go through one or two links of broader categories that do not necessarily suggest containing emergency information. For example, some boroughs file their emergency site under “Businesses”, which would not suggest residents to look into it (Solomon, Personal Interview, March 28, 2013). Hounslow files it under “Advice and Benefits” (Figure 20).

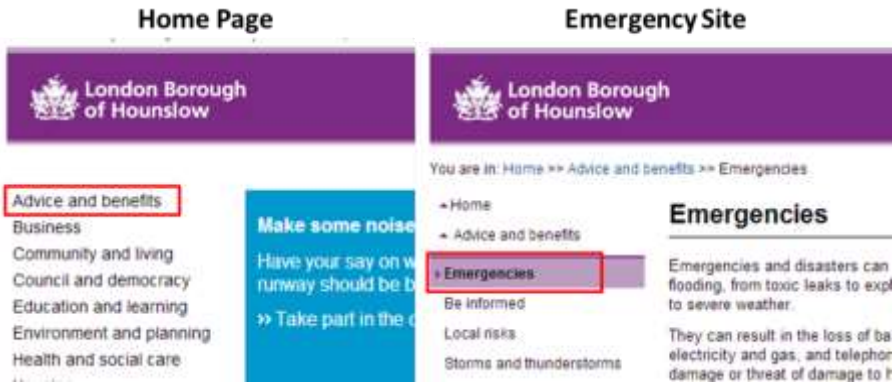

Figure 10- Accessing the Emergency Site on the Hounslow Council Website. Retrieved from: http://www.hounslow.gov.uk/

Since the Council's Communications Team runs the website, using this tool will not incur extra cost for emergency managers. It does take initial time and effort to update the current layout and information; however, the results require minimum maintenance.

4.3.1.2 Council Magazine

The majority of the boroughs have a Council magazine; however, only some use it to disseminate emergency information. The main advantage of this communication channel is its high audience reach. The magazine is sent quarterly to all homes and businesses, making it "an excellent way to reach more people and encourage them to think about emergency preparedness" (Solomon, Personal Interview, March 28, 2013).

Since the Council runs the magazine, the cost and workload required to post emergency preparedness information is minimal. However, the biggest challenge that some emergency planners face is convincing their Communications Team about the importance of posting emergency information, regardless of the likelihood of them happening (Solomon, Personal Interview, March 28, 2013).

4.3.1.3 Educational Programs

An option for successfully preparing the public for an emergency is through educational programs. The emergency organizations alone cannot deal with an emergency without the cooperation of the public. Residents tend to react to a warning much more efficiently if they know their role during an emergency. To illustrate this point, John Sorensen brought up an example of a tsunami. Those that were educated about receding shorelines being a warning sign

of a tsunami, evacuated before the tsunami hit. However, those who were unaware of this fact followed the receding shoreline into the ocean (Sorensen, Personal Interview, March 26, 2013).

Educational programs can raise awareness in people of all ages, which helps develop a more resilient community. Emergency managers increase audience outreach by targeting schools, various faith groups, businesses, or other institutions. Additionally, this method can cause an information cascade. For example, if children are educated about emergency preparedness, they can then bring the information home to their parents, which would raise their awareness as well (Sorensen, Personal Interview, March 26, 2013).

As helpful as educational programs would be for the public, the overall process is time consuming and expensive (Couzens, Personal Interview, April 11, 2013). The heavy workload and cost are based on the creation of the lesson plan and its materials, as well as carrying out the program. Some of the materials include pamphlets, flyers, brochures, or emergency preparedness packages that the students can bring home. It takes time and money to translate these materials as well as modify them for students with disabilities. However, the benefits of educational programs can override the cost and workload.

4.3.1.4 Emergency Preparedness Packages

Emergency preparedness packages provide residents with information on how to protect themselves and their homes before an emergency. Surveys conducted by Havering showed that before delivery of their booklets only 13 percent of the population felt informed about emergencies. After they sent booklets, this number doubled (Clark, Personal Interview, April 9, 2013), indicating that the information delivered seemed to have an impact on the community.

Since preparedness packages can be delivered to the entire population, the audience reach of this method is high. However, it is less time consuming to deliver them to specific populations such as those living in risk zones. Boroughs can decide on what is the most relevant information to include in their packages, based on the emergencies they face and the population they are trying to reach. For example, Redbridge provided residents with flood information packs (Arundell, Personal Interview, April 8, 2013), while Havering sent emergency planning booklets (Clark, Personal Interview, April 9, 2013).

The time, cost, and staff required to create and deliver these packages tend to disengage emergency planners into pursuing this option. Personally delivering these packages increases their effectiveness, but it also increases the time and staff needed. Redbridge emergency officials spent two to three hours every day for three weeks to deliver packages to vulnerable residents. In addition, a big challenge they faced was that residents brought up unrelated complaints to officials, therefore slowing the process (Arundell, Personal Interview, April 8, 2013).

4.3.2 Response Phase

The response phase of emergency management takes place when a hazard is imminent. The goal of emergency organizations is to disseminate warnings and emergency information to the public quickly and accurately in order to minimize the effects of the emergency (County of Los Angeles, 2013). As seen in Table 6, we identified three main options for disseminating information during this phase. We assessed these options based on four criteria that should be considered when choosing effective methods to warn and inform the public (Table 6). These criteria include audience reach, speed, cost, and geo-targeting.

Table 6 - Assessment of Communication Option for the Response Phase of an Emergency

		Assessment Criteria			
		Reach	Speed	Cost	Geo-targeting
Methods	Mass Communication	L-M	H	H	M
	Social Media	M-H	H	L	L
	Community Outreach	L-M	M	L	L

L= Low M= Medium H= High

Ideally, a system should have a high audience reach, fast dissemination, low cost, and geo-targeting capabilities.

4.3.2.1 Mass Communication System

A mass communication system is a tool that allows an organization to use text messaging, e-mail, and phone calls for simultaneously sending out a message to a large number of people. For an emergency planning organization, this system tends to be useful to send out alerts both

internally and externally. However, there is a wide variety of mass communication systems available, and not all systems are equally successful.

Most people in the UK have mobile phones, e-mail accounts, or landlines; therefore, messages delivered through mass communication systems have the potential to reach a high amount of the population. However, few people sign up for the system, which decreases the number of audience reached in an emergency. According to Mileti, on average no more than 12 percent of the population signs up to receive messages from a mass communication system (Mileti, Personal Interview, March 18, 2013). London boroughs are no exception. Redbridge has fewer than five percent (Arundell, Personal Interview, April 8, 2013), and another borough, whose name was withheld by request, has 0.7 percent of registered users. Some boroughs have stated that this could be for various reasons such as being unaware of the system, concerns with privacy protection, or not considering it a priority. On the other hand, Haringey has a relatively high registration with approximately 16 percent of their population in the system because of their opt-out method, rather than using opt-in like most boroughs. Through this opt-out method people calling the Council Contact Center are greeted with a voice recording informing them that their number will be added to the system unless they request otherwise (Meek, Personal Interview, April 2, 2013).

The main advantage of a mass communication system is the speed with which it sends out a message. After a message is constructed, it only takes a few seconds to deliver it. Some systems require people to confirm reading the message; otherwise, a following warning is sent. This shows how emergency planners can quickly reach individuals.

Mass communication systems are the only tools that can send targeted messages by location. This feature is called geo-targeting. Individuals select the postal codes or wards they want to receive notifications from when they sign up, including their home, place of work, or other particular areas of interest. During certain incidents, responders can avoid sending a message to the entire community by only reaching those directly affected (White, Personal Interview, April 4, 2013). However, it is a challenge to keep locations updated to make sure that all the right people get the information.

Although very useful, mass communication systems are expensive. Emergency management organizations must pay a yearly fee in order to run the system and send messages. In addition, some system providers might charge for extra features or customizations. The main question asked by organizations is if paying for the system is worth it, based on the number of times they will actually use it. There are conflicting views on this matter. For example, the emergency planning staff of Tower Hamlets believes that although the system is not used often, when it is used for an emergency warning, it is worth the cost (White & Crawley, Personal Interview, April 4, 2013). On the other hand, the emergency planning officer of Havering believes that the budget could be utilized more effectively by creating more educational programs for the public rather than a mass communication system (Clark, Personal Interview, April 9, 2013). However, every view depends on the prevalent emergencies in the borough and the budget available. Mass communication systems require maintenance and promotion. All of these tasks require time and staff, which are not always available.

4.3.2.2 Social Media

Members of communication teams from emergency organizations can post information, links, or pictures instantaneously and with ease through social media. These sites are growing in popularity as seen in Figures 2 and 3. As more people connect on these sites, the reach of emergency organizations grows online. Although the number of followers may seem small for local organizations, the ultimate reach of the social media site may be much larger because followers can share information. For example, Hounslow has around 750 Facebook followers, relatively small since their population is over 250 thousand (GLA Intelligence Unit, 2012), but their audience reach is around 12 thousand people. Hounslow has around 2 thousand Twitter followers, but their Twitter reaches 50 to 60 thousand people (Amarasekara, Personal Interview, April 9, 2013).

An advantage of social media is its public accessibility. As long as a person has the technology to access the site, anyone can create an account for no cost. However, only certain demographics of the population tend to access these sites. If the target audience is those that actively use social media, such as the youth, then the message will spread quickly in that population (Lenhart et al, 2010).

Responders cannot use social media for geo-targeting capabilities to reach specific groups or individuals affected by small emergencies. For example, it may not be the best tool to warn and inform residents in a certain area about a small fire since social media posts reach the whole audience following online.

A use of social media is pulling information (Sutton, Personal Interview, April 2, 2013). Responders can monitor the sites to see what the public is posting. For example, an official can watch trends on Twitter, or topics that peak in popularity, and possibly notice when an emergency has occurred. Lewisham is expanding upon their use of pulling information on Twitter. Similar to other boroughs, members of their communications team constantly monitor Twitter for posts from the public. They extract information and stay updated with what the public is thinking (Brown, Personal Interview, April 5, 2013).

Unlike other methods, social media allows two-way communication (Sutton, Personal Interview, April 2, 2013). The public can comment on a post or send a message to a borough questioning either the message or the emergency. An official can reply and give information directly to that resident. This reinforcement or clarification of the message can help residents understand the message and believe it. Most other methods are one-way and do not allow for public replies.

Considering the applications of social media and the need to constantly monitor and frequently update the sites, the workload presented to emergency managers is heavy. Multiple boroughs have commented on the workload that social media presents and academic experts stress the fact that if emergency organizations plan to use social media, they need to do it well (Stokoe, 2012).

4.3.2.3 Community and Business Outreach

Communicating through the institutions or circles where social vulnerable groups operate, such as neighborhood association, schools, clubs, faith groups, adults and children's services, and voluntary agencies, increases the audience reached.

Many institutions have already established systems to inform their groups. By building a relationship with key staff, emergency planners can take advantage of these existing channels of communication to pass on emergency information. This creates a cascade system in which the Council informs community leaders and then they spread the message to larger groups, which

might not have access to the information through other channels. For example, Barnet has a large Jewish population so they use contacts from the Community Security Trust, a private security firm for the Jewish community in the area, to get messages out to that group (Solomon, Personal Interview, March 28, 2013).

People will believe a warning message more if it delivered by an organization they trust. Moreover, the Council develops a generic warning statement about the emergency; but these organizations can make the information specific to their users, including delivering it in the right context and language (Arundell, Personal Interview, April 8, 2013).

The main challenge this method presents is that emergencies can occur at any time; however, contacts from institutions or community groups will not necessarily be on-call if an incident occurs after office hours. This tends to reduce the number of people that the Council can reach and the ability to cascade information quickly.

4.3.3 Recovery Phase

The last phase of an emergency is the recovery phase when responders assist the public in returning to normality. The public should receive information such as shelter locations, contact details of utilities, and updates of the recovery. Similar to the preparedness and response phases, a high audience reach, low cost, and geo-targeting capabilities can be important when applying certain communication methods.

We suggest applying social media and the Council website in order to disseminate information (Table 7). Both options have similar values when assessed by the criteria. As described in the response phase, social media reaches a wide audience if a good portion of the population is techno-literate and stay connected through social media sites. The website is accessible to everyone as long as they have the technological means to do so. Both methods require minimal cost and do not have geo-targeting capabilities.

Table 7 - Assessment of Communication Option for the Recovery Phase of an Emergency

Methods	Assessment Criteria		
	Reach	Cost	Geo-trageting
Website	M-H	L	L
Social Media	H	L	L

L= Low M= Medium H= High

During the recovery phase, the public is alert and aware of emergencies and tends to be motivated to take action and increase their preparedness for the future. The CPU should take advantage of this behavior to increase community resilience, leading them back to the preparedness phase.

4.3.4 Additional Consideration

The options to warn and inform the public described above rely on certain resources such as electricity. Emergencies are unpredictable and these necessary resources might become unavailable. Therefore, emergency planners need options for worst-case scenarios that may depend on old-fashioned methods such as door-to-door warnings and officials going through neighborhoods with loudspeakers (Clemons, Personal Interview, March 22, 2013). In these cases, information output may heavily rely on leaflets instead of a website, mass communication system, or social media, but the production of these papers could be limited. Officials need plans to generate these materials off site in another borough or in cooperation with another organization. If emergency managers have multiple options available, then it is more likely they have a chance of providing information to the public when some methods do not work.

5.0 Recommendations

In this section, we provide recommendations specific to Hounslow based on the assessment made above. We took into account the limitations of the Contingency Planning Unit (CPU), including budget and staff, and the importance of multichannel communication.

5.1 Council Website

The emergency site of the Council website is the main source of information for Hounslow; however, it is not easily accessible. In order to access the emergency site, people need to go through the "Advice and Benefits" link. Many residents may not realize that there is emergency information under this link, discouraging them from reading it. The Council should either have a direct link to the emergency site on the website's home page or rename the current link to "Advice, Benefits, and Emergencies". This will clarify to residents where to look for emergency information.

Currently, all the necessary information is on the website; however, this should be presented in a more viewer-friendly fashion. Pictures can highlight the impact and importance of emergencies, figures and graphics can present data in an appealing format, and widgets may interest the user. For instance, a widget could be a live Twitter feed with posts from relevant emergency organizations including the London Fire Brigade and Metropolitan Police Service. Features similar to these will help inform the public and draw their attention to the website.

Given Hounslow's high diversity, the website should target social vulnerabilities such as age groups and ethnicities. Preparedness information can be specific for certain groups including children, seniors, disabled persons, and businesses. For example, a section for children could have activities such as puzzles or crosswords for them to learn but also enjoy. Ethnically diverse groups would benefit from translation services available on the webpages. It is unrealistic to provide translations for more than 140 languages spoken in Hounslow; but at least the top three spoken languages in the borough should be available. These additions may widen the extent of people reached.

During an emergency, the Council's main page should provide information on the home page instead of users searching for the emergency site. Additionally, the Communications Team could

post videos with live news coverage, weather updates if relevant, numbers to call, and links for further information. After the emergency, the CPU team can give a direct link to available shelters, nearby hospitals, or any other relevant information.

5.2 Council Magazine

The CPU should take advantage of the Council magazine, *Hounslow Matters*, for emergency communication purposes. Since the Council sends the magazine to residents and businesses quarterly, preparedness tips can change based on the most common disasters of the season. For example, for the winter issue they can include information about snowstorms or other likely emergencies. Adding a take-away that residents can keep, such as a magnet with useful emergency contact numbers, would also be helpful. It will probably draw the reader's attention to the page with the emergency information and, if the reader keeps the magnet, they could use it during emergencies.

5.3 Educational Programs

In the past, the CPU has implemented educational programs where residents can learn about their roles during an emergency. The program they used was called "Junior Citizen" which recently changed to "Think Safe" (Think Safe, 2013). This program allows children to take part in mock ups of dangers or emergencies, in order to teach them how to deal with these situations. We recommend the CPU to collaborate with other blue light services to reinstate this program in order to target children as well as reduce the workload for the CPU staff.

The CPU should also offer emergency preparedness training for adults. These trainings can be done for religious organizations, hospitals, universities, or businesses. For example, Hounslow Homes, an organization owned by the borough of Hounslow and responsible for 16,500 homes, has a program that provides free classes and training for its tenants (Hounslow Homes, 2012). The CPU can work in collaboration with Hounslow Homes and incorporate a class about emergency awareness into their program.

5.4 Emergency Preparedness Packages

We recommend the use of hard copy materials during the preparedness phase of an emergency. It would be helpful to make and deliver emergency preparedness packages, which can include emergency contact numbers, grab bag checklists, preparedness tips, and examples of previous hazards in the borough. The borough of Hounslow has a supply of brochures in stock that they could use for this purpose. This measure will help raise awareness of emergencies among the population.

There are different ways the Council could deliver these materials. For instance, officials can personally distribute packages to the neighborhoods that are in higher risk of flood. Emergency management staff can stand in public areas and distribute the flyers or brochures to by-passers. They can also disseminate information at local public events and centers frequented by many people. Copies of these materials should also be available online.

5.5 Mass Communication System

A recommendation for Hounslow is to consider incorporating a mass communication system into their methods for warning and informing the population. We recommend that the CPU collaborates with the Hounslow Metropolitan Police which is already using a mass communication system called Neighborhood link, or with the Hounslow Council which is looking into obtaining a system. If the system is shared by multiple organizations it will be cheaper and will be used more. It would also save time since Council or Police staff would be responsible for managing it, instead of CPU staff.

The Council should consider a few factors when analyzing mass communication systems. There should be the option of customizing the system to the needs of the CPU without additional costs. The system should be affordable and Hounslow should avoid charging its residents to sign up. Overall, the simpler the system is, the easier it will be to use during an emergency. Geo-targeting by ward or postal code is an important feature to incorporate into the system.

In order to increase registration numbers, we recommend using Haringey's opt-out strategy. Anyone who calls the Council will be automatically registered, unless they indicate otherwise. In addition, Hounslow should employ more methods to allow people to register on their own. These

methods can include registering through their website, mail-in forms, and have forms available at the Council. We also recommend that users should be responsible for updating their information; however, a yearly reminder to the user would be beneficial.

5.6 Social Media

We recommend focusing on Twitter and Facebook out of the possible social media sites. Emergency organizations regard these two platforms as the best to provide information to the public. We also suggest an emphasis on Twitter over Facebook. Emergency planners may rely on Twitter more for immediately publishing information in real time. Tweets are short and concise and officials can post updates regularly as the situation progresses (Sutton, Personal Interview, April 2, 2013). Facebook posts tend to be longer and signpost users to a website for further information.

Organizations can monitor Twitter more easily than Facebook (Sutton, Personal Interview, April 2, 2013). Trends highlight recently popular topics. Responders can search key words about an emergency and read information the public is posting. However, Facebook only allows emergency management organizations to view comments from the public on their posts.

Through both Twitter and Facebook, we recommend using two-way communication. If a message is unclear or misleading then the public can pose questions, emergency organizations can make themselves clear, and others can see these corrections.

5.7 Community and Business Outreach

The CPU should hold an updated and organized list of contacts from community and business leaders. These contacts can assist in warning and informing the public during an emergency by spreading the information to their respective groups. The CPU should work closely with the Community Partnership Unit, since they possess this information and can assist in the process.

Inviting the contacts to emergency planning meetings or seminars, helps make sure they are aware of current emergency practices. Additional trainings can highlight emergency preparedness, communication systems, and business continuity.

Since the community leaders hold authoritative roles in their respective groups, people are more likely to listen to them. Therefore, they can also help by encouraging people to follow the Council's social media pages or sign up for a mass communication system.

5.8 Additional Considerations

5.8.1 Measuring Effectiveness

The CPU should measure the reach and effectiveness of the tools they use to communicate with the public. However, they have found this to be a very challenging task. For technological tools such as the website and social media, they could look at the number of viewers and the increase in followers during the emergency, nonetheless this does not indicate if the people understood the message or took protective actions. Using surveys sent to the public or taking advantage of the two-way communication of social media, preferably before an emergency occurs, are other methods to help measure effectiveness.

However, it is such a complex matter that at the end of the day it comes down to sending a clear message through all the communication channels available and hope people will react positively.

5.8.2 Council Internal Communication and Cooperation

We learned that collaboration and internal communication is essential for warning and informing. Relationships between organizations should be maintained and open. For example, the Hounslow Communications Team sends out all Council messages and maintains the Council website. The CPU should understand how the Communications Team works and how that team can help or assist in emergencies. If the Communication Team understands how the CPU proceeds with warning and informing, they can provide recommendations and assistance. These two teams can help each other improve their performance.

Collaboration between different emergency organizations will cut down on time and money while also increasing the effectiveness of some methods. For example, the CPU should team up with the blue light services including Metropolitan Police to conduct successful educational programs.

5.8.3 Advances in Technology

Communication patterns are constantly changing in society. Emergency managers need to stay informed on changing trends and new technologies in order to adapt their communication systems to the public they serve. For example, three years ago people were using Bebo. Now, many people use Facebook and Twitter (Meek, Personal Interview, April 2, 2013). In the years to come, these trends are likely to change and modifications must be made accordingly.

6.0 Conclusion

We conclude that emergency organizations should use a combination of tools when disseminating information in order to reach a wide range of the population. Each person does not use the same technologies, therefore only using one tool would be ineffective. The communication options range from traditional methods such as hard-copy materials to innovative technologies such as mobile text messaging and social media.

Additionally, the message needs to be consistent across all channels used. The content of the message is just as important as the method of dissemination, and emergency managers need to construct it carefully to avoid confusion. The public responds to warnings differently depending on the way the message is written. Overall, public response needs to be taken into consideration when both creating the message and disseminating it.

Future research should assess the effectiveness of the proposed emergency communication methods. These assessments will allow further improvements to the Hounslow communication system. Additionally, it is important for the Contingency Planning Unit to keep up with evolving technologies. This continuous process will allow them to best warn and inform their local population before, during, and after an emergency.

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Appendices

Appendix A: Sponsor Description

London compromises 32 boroughs. Hounslow is one of 19 outer boroughs and lies along the western edge of London (Figure 11) ("List of Inner/Outer London Boroughs", 2013). Hounslow covers 22 square miles and is the tenth largest borough by area ("Hounslow borough profile", 2006).

Figure 11 - Borough of Hounslow. Retrieved from: http://directory.londoncouncils.gov.uk/directory/hounslow/officers/

Hounslow is "a large, leafy and ethnically diverse borough stretching from Chiswick in the east to Heathrow Airport in the west" (All in London, 2013). The three key infrastructural features of Hounslow are the River Thames, the M4, and Heathrow Airport (Figure 12).

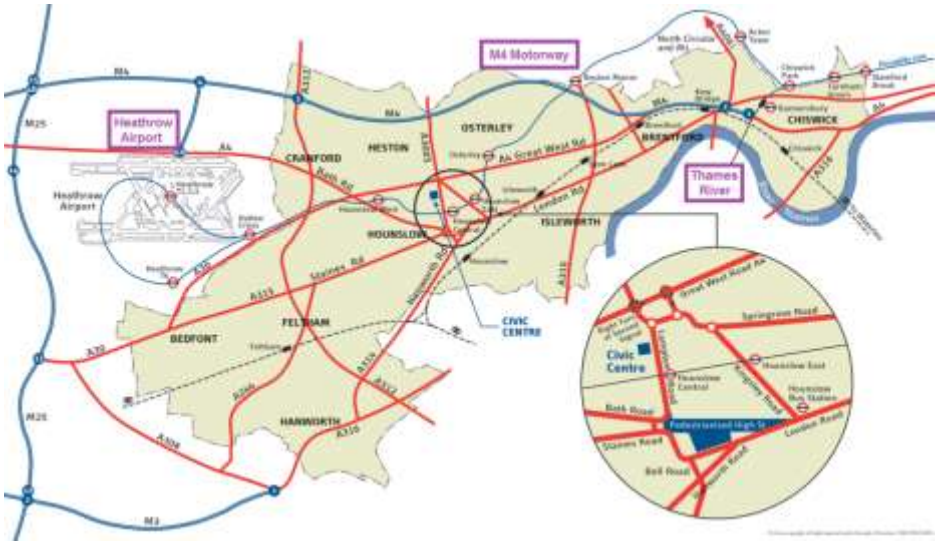

Figure 12 – Key Infrastructural Features in Hounslow. Retrieved from: http://www.hounslow.gov.uk/hounslow_borough_map.pdf

The river runs along the southeast border of Hounslow. The M4 motorway runs east and west along the northern edge of the borough and is a major connector between Heathrow Airport and central London. Heathrow Airport is a major international airport and is located in Hillingdon, on the western edge of Hounslow. Heathrow is the busiest airport in the UK and the third busiest airport in the world by passenger traffic, serving 69.4 million passengers in 2011 (Heathrow, 2013).

The population of Hounslow has increased from 212,328 in 2001 to 254,000 in 2011 according to census data. During the same period, the number of households increased by 12.98 percent reaching 94,900 households in 2011 with an average household size of 2.66 people. The majority of the population (64 percent) is between 20 and 64 years old (Figure 13), which is defined as 'working age' (GLA Intelligence Unit, 2012). Closer analysis of age distribution by area shows that Heston and Cranford and the West Area are dominated by a younger population, ages 0-15 (Figure 14).

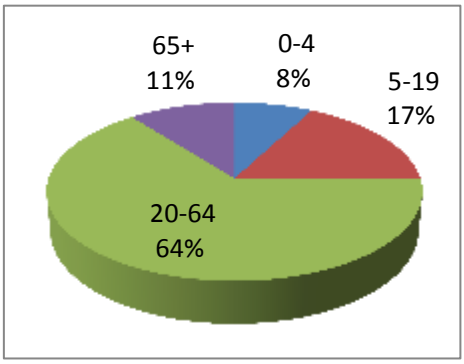

Figure 13 – Population by Age, 2011. Retrieved from: http://data.london.gov.uk/datastorefiles/documents/2011-census-first-results.pdf

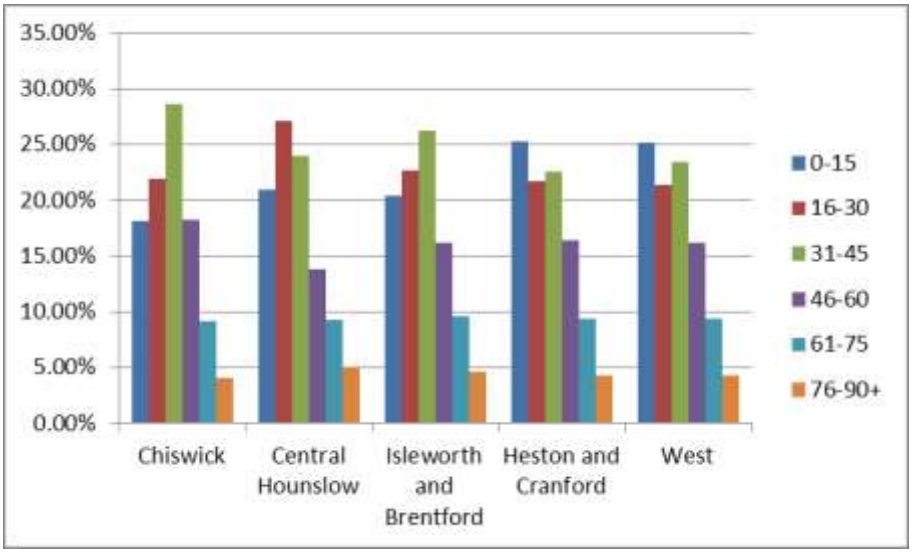

Figure 14 - Distribution by Area. Data retrieved from: http://data.london.gov.uk/datastore/applications/custom-age-tool-gla-population-projections-ward

The population is ethnically diverse with 65 percent of the population being white, 25 percent of the population being Asian or Asian British, and the rest split between other ethnicities such as Chinese, Black, or Mixed (Figure 15). The borough is home to 48,161 Indians, which is the fourth largest population of Indians in London (Office for National Statistics, 2012). The borough is also very culturally diverse, and over 140 languages are spoken by residents. The most diverse areas are Heston and Cranford and Central Area (Figure 16). Hounslow has a diverse economic base, with a strong mix of wholesaling, transport, and communication businesses related to its proximity to Heathrow, the M-4, and central London (Figure 17) ("Industry of Employment", 2013).

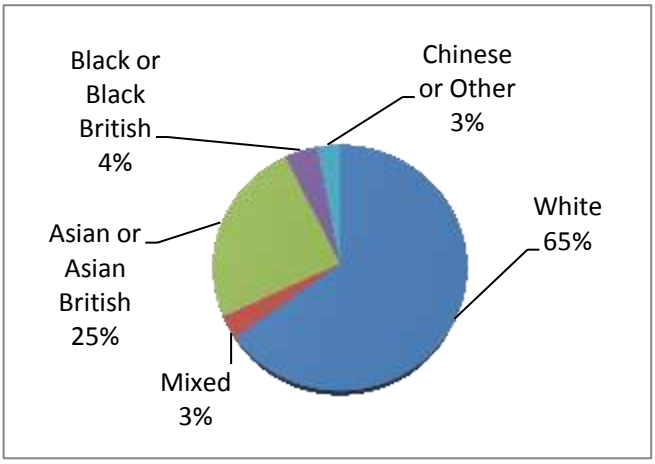

Figure 15 - Ethnicity in Hounslow. Retrieved from: http://www.hounslow.gov.uk/all_people_ethnic_group_hounslow_borough-2001census.pdf

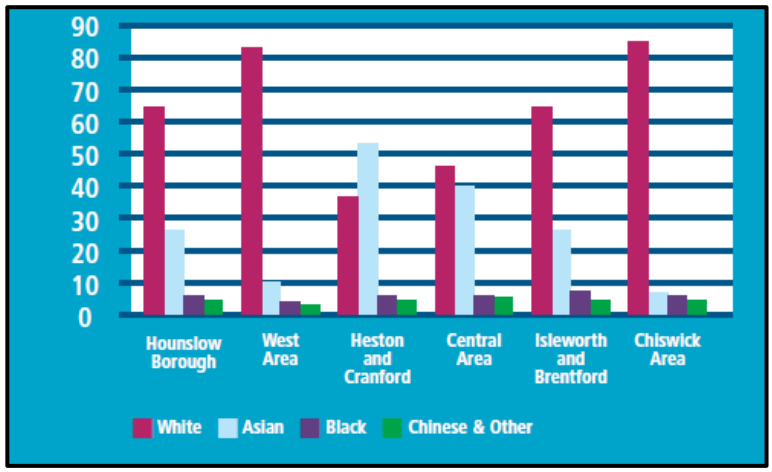

Figure 16- Ethnicity across Hounslow (%). Retrieved from: http://www.hounslow.gov.uk/community_plan.pdf

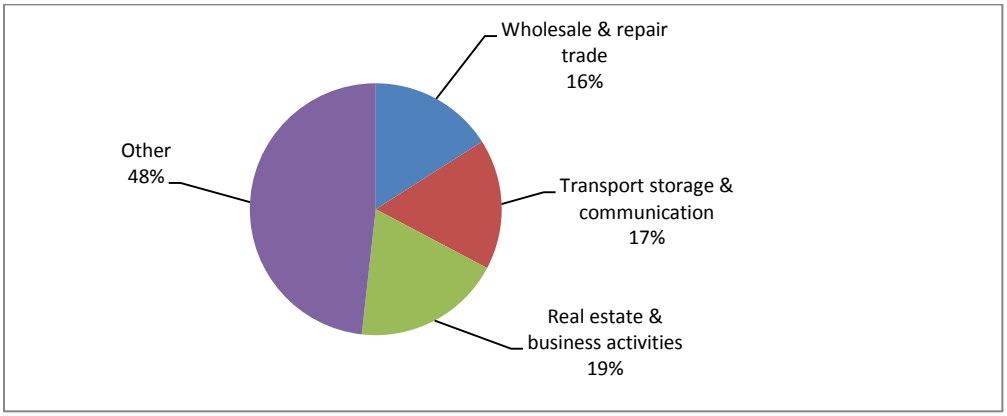

Figure 17 - Economic Activities in Hounslow. Retrieved from: http://www.hounslow.gov.uk/all_people_ethnic_group_hounslow_borough-2001census.pdf

The Hounslow Council operates by a very simple mission: "Our vision for future local government in Hounslow is as a community leader, not simply a provider of services" ("About the Council", 2013). With this focus in mind, the Council strives to improve the sense of community in the borough through the use of modernized local democratic processes. As a part of the first wave of Councils in London to update the function of the government in 1999, Hounslow helped develop and exercise the pilot to establish their current executive, scrutiny, and area committee structure. This structure was finalized after consultations with the community and volunteer agencies. After the 18 month pilot period, the Local Authorities Act 2000 was put into place.

As of the 2010 election held in May, the Labour Party controls the Council with 35 councillors and the Conservative Party rounds the Council out with 25 councillors, making a total of 60 elected officials, three from each ward, in the full Council. Since the wards have very different economic and socio-demographic complexion they tend to vote differently. We can see that, by comparing the 2010 regional election results (Figure 18), the 2010 indices of multiple deprivation (Figure 19), and the ethnicity distribution (Figure 16) across Hounslow, the less wealthy and more ethnically diverse areas tend to vote Labour. The Labour party retained control of the Council except for two four-year periods, one in 1968 when the Conservative Party took over and another in 2006 when neither party held a majority (BBC News, 2010). The full Council only meets around ten times per year to agree on the tax base and budget, elect the mayor, and decide the main policy framework ("About the Council", 2013).

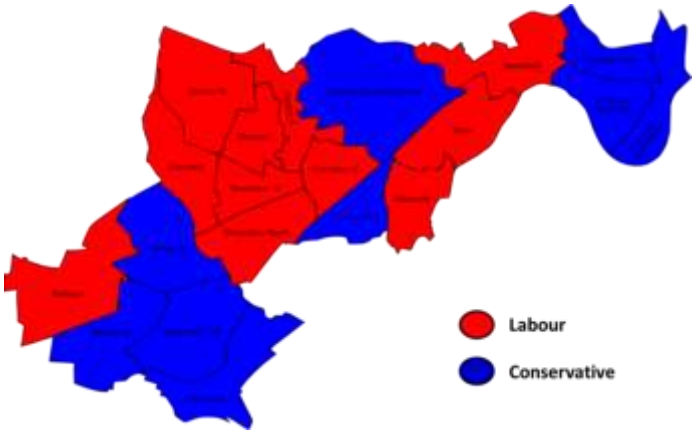

Figure 18 – Hounslow Local Elections 2010 Results. Retrieved from: http://www.andrewteale.me.uk/leap/map/2010/13/

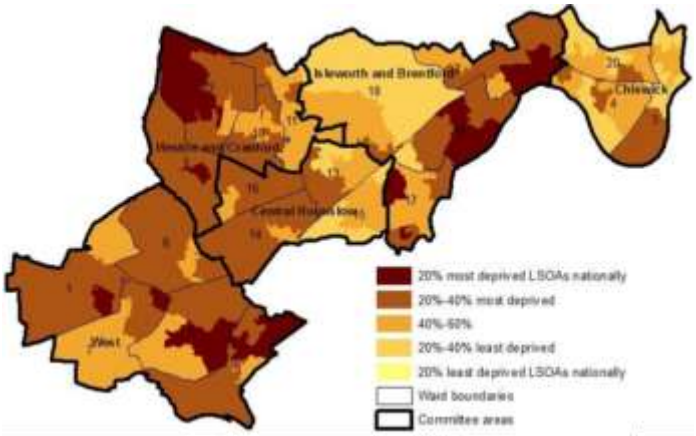

Figure 19 - Index of Multiple Deprivation 2010. Retrieved from: www.hounslow.gov.uk/local_economic_assessment_everview.pdf

The Council, comprised of elected officials and employees, is divided into the Cabinet, Area Forums, Overview and Scrutiny, and Departmental Structure (Figure 21). The Cabinet is formed by 10 councillors, including the Council leader. The Cabinet oversees the running of the Council and ensures that all policies are carried out within the Council budget ("About the Council", 2013). The Area Forums are five different committees, one for each region (Figure 20), which monitor the delivery of service for each area. These forums help promote the citizen involvement in local government since their meetings are held in public and up to three residents can be invited to participate ("Area forums", 2013). Overview and Scrutiny acts when issues must be considered in detail. They present their reviews to the Chief Executive, who promotes the creation of proposals to amend these issues. Finally, the Chief Executive also supervises the Council employees who are hired under different departments and offices to implement the policies and deliver the various services provided by the Council, such as schools, roads, and rubbish removal. These departments are funded through the Council budget ("About the Council", 2013).

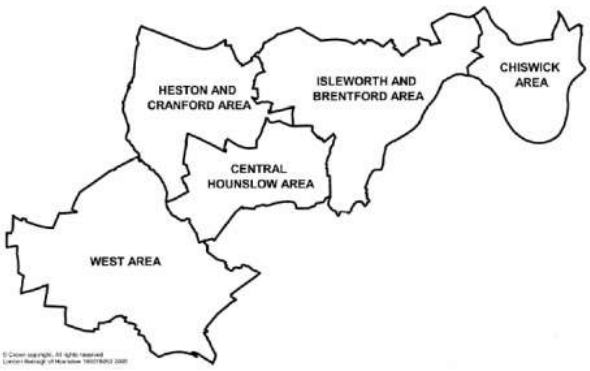

Figure 20-Area Forums of the Council. Retrieved from: http://democraticservices.hounslow.gov.uk/(S(stfpefe112kgwr45ccopppad))/mgConvert2PDF.aspx?ID=24135

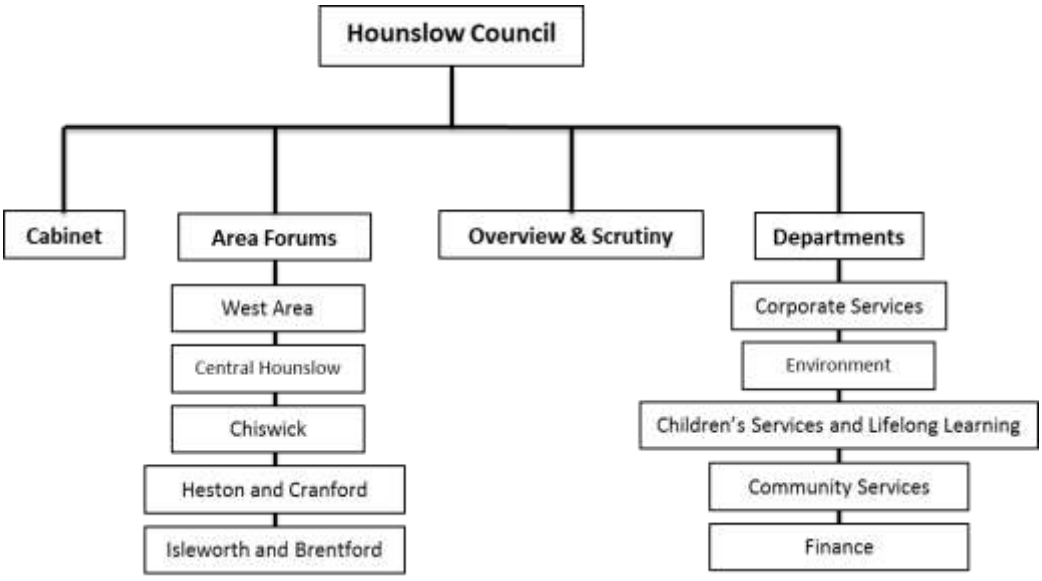

Figure 21 - Cabinet Structure. Data retrieved from: http://www.hounslow.gov.uk/index/council_and_democracy/about_hounslow.htm

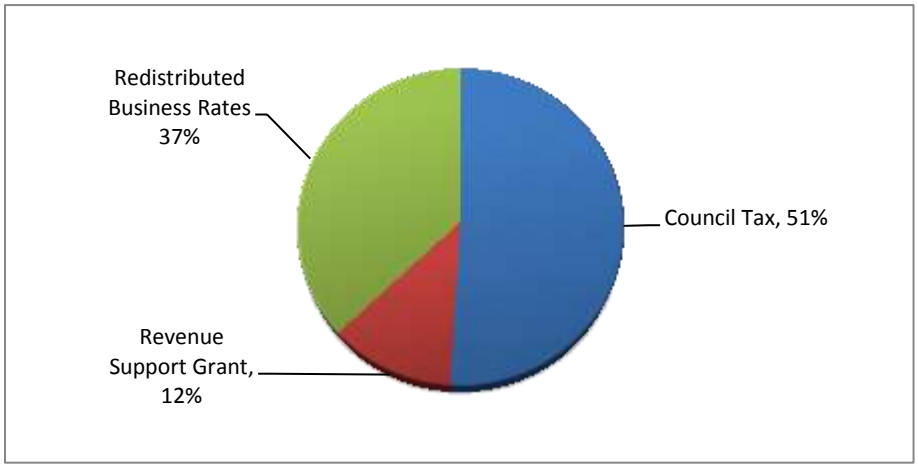

Figure 22 - Funding Sources for Net Revenue Expenditure 2011/12. Retrieved from: http://www.hounslow.gov.uk/key_financial_statistics12.pdf

The Borough Council approved a budget of £185.8 million for 2011/12. This Council has three main sources of revenue: Council tax, redistributed business rates, and revenue support grant (Figure 22) ("Statement of accounts", 2012). Fifty one percent of the Council's revenue comes from Council taxes, which are paid by all the residents of the borough who own a home. The amount each resident must pay depends on the value of their property ("Council tax bands", 2013). Business rates are collected by the Council for the national government and paid into a central pool. The money is then redistributed to local authorities based on their adult population and it represents 37 percent of the Council funding for Hounslow (West Berkshire Council, 2012). The revenue support grant, which corresponds to the remaining 12 percent of the funding, is a grant given by the central government to support local authority services.

This budget is allocated across the different departments of the Council which include Chief Executive, Environment, Children's Services and Lifelong Learning, Community Services, and the Corporate Services (Figure 23) ("Key Financial Statistics 2011/12", 2012). The biggest expenditure corresponds to the Community Service Department, which includes housing and adult social services, with an amount of

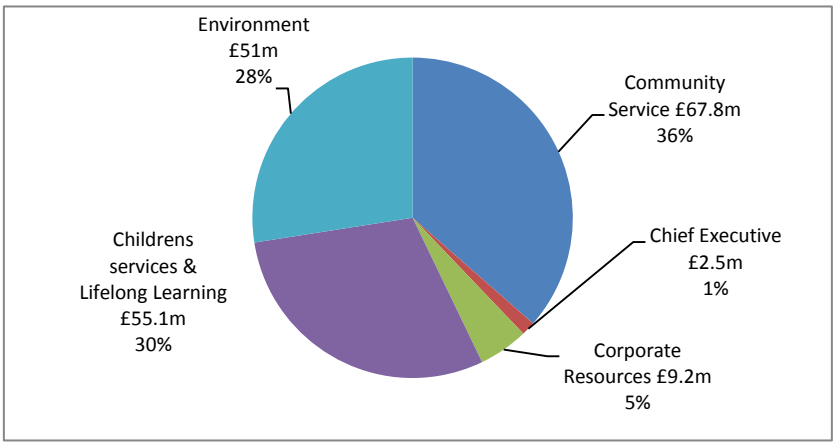

Figure 23 - Departmental Net Expenditure Original Budget 2011/12. Obtained from: http://www.hounslow.gov.uk/key_financial_statistics12.pdf

£67.8 million. It is followed by the Children's Services and Lifelong Learning Department, which mainly includes school education and children's social care, with £55.1 million. The third biggest allocation of money, with £51 million, corresponds to the Environment Department ("Key Financial Statistics 2011/12", 2012). This department is in charge of promoting the improvement and protection of the local environment, while planning towards environmental sustainability ("Environment and planning", 2013).

Appendix B: Flood Assessment in Hounslow

The River Thames on the south, River Cane on the east, and River Brent on the west surround Hounslow, making flooding a constant concern. Of all of the hazards that threaten the borough, riverine flooding and surface water flooding are the most prevalent.

Flooding can occur due to various reasons such as river flooding, localized runoff, and sewer flooding ("London Borough of Hounslow Strategic Flood Risk Assessment", 2007). The analysis of the previous flood history of the borough helps identify areas of foreseeable flood danger. Fluvial flooding caused by the River Thames and River Brent happened in Brentford and the Chiswick Mall. Surface water flooding due to backing-up or drainage network has previously occurred in Hanworth as well as in the east of the Feltham Area. Surcharging of surface water and combined sewers has occurred in the south east of Feltham, north of Isleworth, and east of Brentford. The flood of the Duke of Northumberland River affected the Modgen Land and Rugby Road near the Twickenham Rugby Stadium. Due to their previous history, all these areas are at a higher risk of a flood and therefore the population within those areas is more vulnerable to a future flood.

Understanding the areas that are in most danger is crucial for successful emergency management. Responders can take measures before a flood occurs to monitor the area as well as to provide the population with proper emergency evacuation routes and instructions. In order to understand which areas are in the most danger of a flood, the borough has been divided into four flood zones based on the probability of a flood in the area. Zone 3b also known as "The Functional Floodplain", is the area in which water will flow and be stored when a flood occurs. Zone 3a is composed of areas of high probability of flooding that have a 1 percent chance of a river flood or a 0.5 percent chance of a tidal flood in a year (Figure 24 and 25). Zone 2 defines areas of medium probability of flooding and has a 1 percent to 0.1 percent probability of a river or tidal flood in a year (Figure 26 and 27). In Zone 1 are the areas of low probability of flooding that have less than 0.1 percent chance of any type of flooding in a year ("London Borough of Hounslow Strategic Flood Risk Assessment", 2007).

Figure 24– Hounslow - Tidal Zone 3 Flooding. Retrieved from: http://www.wpi.edu/Pubs/E-project/Available/E-project-042711-173731/unrestricted/Modeling_Flooding_in_the_Borough_of_Hounslow.pdf

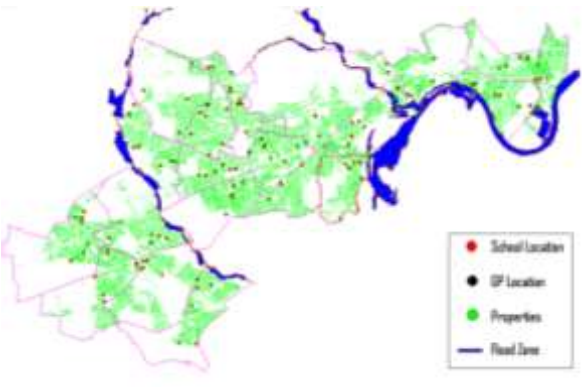

Figure 25- Hounslow - Fluvial Zone 3 Flooding. Retrieved from: http://www.wpi.edu/Pubs/E-project/Available/E-project-042711-173731/unrestricted/Modeling_Flooding_in_the_Borough_of_Hounslow.pdf

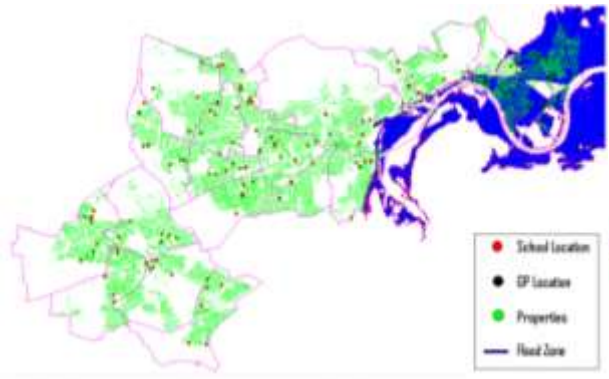

Figure 26 - Hounslow - Tidal Zone 2 Flooding. Retrieved from: http://www.wpi.edu/Pubs/E-project/Available/E-project-042711-173731/unrestricted/Modeling_Flooding_in_the_Borough_of_Hounslow.pdf

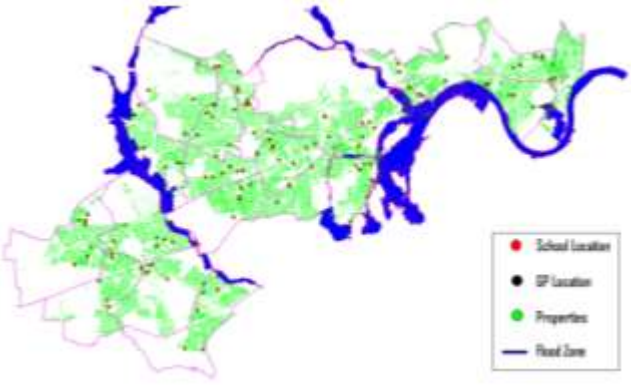

Figure 27- Hounslow - Fluvial Zone 2 Flooding. Retrieved from: http://www.wpi.edu/Pubs/E-project/Available/E-project-042711-173731/unrestricted/Modeling_Flooding_in_the_Borough_of_Hounslow.pdf

Hounslow has a population of 254,000, around 94,900 households, and an average household size of 2.66 people (GLA Intelligence Unit, 2012). According to the UK Environment Agency, approximately 16,500 properties are in areas at risk of flooding, which constitutes roughly 15 percent of properties in the borough. However, the National Flood Risk Assessment shows that 89 percent of the properties are in areas of low likelihood of flooding due to protection provided by tidal defenses (Figure 28). Approximately 32,700 properties are in areas at risk of surface flooding at potential depths of greater than 0.1 meters, and approximately 5,900 properties are in

areas at risk of flooding to potential depths of greater than 0.3 meters (Environment Agency, 2011).

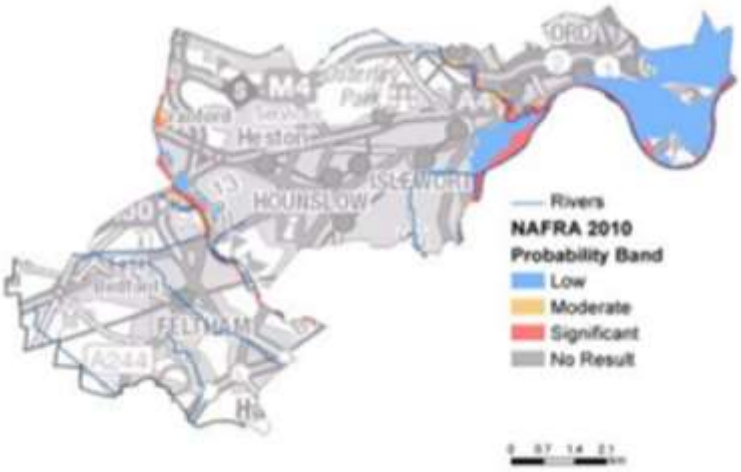

Figure 28- Nafra 2010 Probability Bands – Likelihood of Flooding in Hounslow. Retrieved from: http://www.environment-agency.gov.uk/static/documents/Research/Hounslow_2011.pdf

Analyzing the risk zones allows emergency organizations to assess the population and properties that are in the most danger.

Appendix C: LESLP Major Incident Procedure Manual

The London Emergency Services Liaison Panel (LESLP) created its Major Incident Procedure Manual to outline the general procedure of an emergency situation. It outlines the role of each emergency service, the cooperation between the services, and instructions on how to handle the emergency once on site (London Emergency Services Liaison Panel, 2012).

Rescue is the primary focus of all the services. The London Fire Brigade deals the most with rescue. The transportation of victims lies with the London Ambulance Service. The police coordinate the different services alongside those functions of the local authorities. Communication is essential between these three main services and especially communication to the local and national level. Each service has its own method of communication; the primary communication tool being TETRA based radios. Each individual agency has its own talkgroup, but can still access talkgroups of a more broad definition. The local authorities also have their own radio systems, but it is ensured that each borough has TETRA radios and a talkgroup to communicate with the other boroughs (London Emergency Services Liaison Panel, 2012).

It is emphasized that the best method of communication is verbally in person. There are groups that meet in person during an emergency, located off scene, that coordinate the responses of the different organizations involved. Minutes are taken so that each service brings to the table their current actions but also is informed of all other actions currently being taken. A Gold Coordinating Group consists of representatives from the blue light emergency services, including police, fire, ambulance, and local authority. The Gold meeting discuss many issues including the task of warning and informing the public and how to deal with the media in general. Methods to inform the public listed in the Major Incident Procedure Manual are television, radio, internet and "new" media, P.A. systems for a local audience, and door-to-door communication (London Emergency Services Liaison Panel, 2012).

Statements to the media are prepared in cooperation with the police and the other emergency services on hand. Each gives their current level of response. These statements should be published on the websites of the organizations and posted on social media sites such as Facebook and Twitter. The media monitor the internet to find information posted on organization websites and eyewitness accounts. With the advance of technology, more and more people are posting

pictures and videos of the emergency online and the media uses these to broadcast live information (London Emergency Services Liaison Panel, 2012).

The Major Incident Procedure Manual emphasizes the fact that media is now uninterrupted and social networking sites, such as Facebook and Twitter, have accelerated the spread of information online. Informing the public is crucial to help calm the public and improve the perspective on the emergency services at work. Suitable methods and messages must be used to correctly inform the entire population, ease concern, and provide instructions on proper actions to be taken (London Emergency Services Liaison Panel, 2012).

Appendix D: Interview Script

This appendix includes the preambles—one for the US and one for the UK—and main questions we asked during our interviews in order to complete objectives one and two. We interviewed four different groups—emergency response organizations representatives from the US (e.g. MEMA, Worcester Emergency Management), London Borough Emergency Control Center staff, mass communication system provider representatives, and academic experts—about current warning and informing systems and public response to warning messages. Each group has its own set of questions. Before each interview, we reviewed the questions and tailored them as necessary.

US Preamble

My name is (team member) and I am part of a student project team from Worcester Polytechnic Institute in Worcester, Massachusetts. Our project involves developing a toolkit of methods to warn and inform the population of the borough of Hounslow in London about emergencies such as flooding or other foreseeable emergencies. We would appreciate the chance to learn about the methods used in your organization. Is this a good time for you to answer some of our questions or would you rather have us call at another time?

No:

> Reschedule
>
> Is there someone else in your organization that you could direct us to?

Yes:

> Before we begin the interview, we would like to let you know that this interview is voluntary and you may stop the interview or refuse to answer any of the questions at any time. We will be taking notes if that is okay with you.
> Do you mind if we quote any portion of this interview in our report? If you prefer, we can use an anonymous pseudonym. We will send you our paper before it is finalized so you can review the sections in which you referenced or quoted.

UK Preamble

Our names are [team members present] and we are a student project team from the United States conducting research in cooperation with the Contingency Planning Unit in Hounslow, led by Twm Palmer. We are developing a toolkit of methods to warn and inform the population of Hounslow of foreseeable emergencies. This interview will help us further our research.

Before we begin the interview, we would like to let you know that this interview is voluntary and you may stop the interview or refuse to answer any of the questions at any time. We will be taking notes during the interview if that is okay with you.

Do you mind if we quote any portion of this interview in our report? If you prefer, we can use an anonymous pseudonym. We will send you our paper before it is finalized so you can review the sections in which you are referenced or quoted.

Questions

US Emergency Management Organizations

What methods have you used to communicate with the population during the preparedness, response and recovery phases of recent emergencies?

Do you have separate procedures depending on the nature of the emergency?

How do you deal with vulnerable populations such as: the transient population, elderly, youth, and ethnically diverse?

How do you deal with warning and informing businesses?

What methods did you use in the past that did not work as well as you anticipated?

Have you used social media tools such as Twitter, Facebook, apps, and/or blogs for emergency communication? If so, when did you start using these methods?

How effective have they been and what was the public response to these methods of communication?

Do you currently use a mass notification system? If so, what are some of the main and most useful features of this system?

What prompted you to start using this system? If anything, what did you use before?

Can this system be used to target ethnically diverse populations that speak different languages?

What are some methods/channels people can use to sign up for the system?

Are there any fees for the residents?

How do you publicize the system to the general population and what percentage of the population is currently signed up for the system?

What would you consider to be the disadvantages of the system? Is there anything you would like to see changed?

Do you have any suggestions for other organizations or people within your organization that we could contact to get more information in the field?

We really appreciate you taking the time to answer these questions. They have been useful for our research.

London Borough Emergency Control Centers

Which methods does your borough use to warn and inform the public during the preparedness, response and recovery phases of foreseeable emergencies?

How do you deal with vulnerable populations such as transient populations, elderly, youth, and ethnically diverse especially those speaking a different language?

How do you deal with warning and informing businesses?

We have a few questions regarding the mass notification system you use, if you use one:

Which company provides this system?

Would you expand upon the features of the system?

When did you start using it and what prompted you to start using this system?

What methods/channels people can use to sign up and how do you publicize the system?

Are there any fees for the residents?

What percentage of the population is currently signed up for the system and what do you do to increase this number?

Regarding the message you send out, what is included in the message and who is responsible for sending it?

What would you consider to be the disadvantages of the system? Is there anything you would like to see changed?

Are you looking into other methods to warn and inform the public?

Do you have any suggestions of people that we could contact to get more information in this field?

We really appreciate you taking the time to answer the questions. They have indeed been useful for our research.

Mass Communication Providers

Would you give us an overview of what your mass notification system entails?

Has your system already been implemented anywhere in London or the UK? If not, are there any current plans of implementation?

What are the methods or channels people can use to sign up for the system?

Are there any fees for the residents?

Do you offer tools to publicize the system to the public or is it dependent on the organization implementing the system?

How long does it take to get the message out to the public?

Could you describe the redundancy of the system? Are there are multiple ways to reach a person or will the system provide confirmation once the message is received?

Is the system general for all of the borough or can you receive notifications based on your ward/address or current location?

What would the system have to offer with dealing with the transient population and businesses?

What would the system have to offer with dealing with diversity in the borough including language barriers?

Thank you for talking with us.

Academic Experts

Would you please provide us with some background of your experience and the research you have done concerning emergency communication?

The borough in London we are working with is very diverse with respect to ethnicity, age, and social status. Through your research, what have you found about how different groups react to emergency warnings?

What options should be considered to best reach the vulnerable groups such as the elderly, children and transient populations?

What are some options through which businesses can be warned and informed?

What are some methods through which those most affected by the impending emergency can be reached?

What are some strategies that we could use to get people involved in emergency preparedness (e.g. sign up for a text message alert system)?

We found out that the message is the most important part of an emergency warning. What guidelines should be followed when constructing an emergency message?

How often should the message be repeated?

What would you consider to be the best way to monitor the effectiveness of emergency communication systems?

We are aware of tools like CMAS and IPAWS, which could be used nation-wide, but if you had to recommend an innovative type of technology or method for a small local community and with a limited budget, what would it be?

In general, could you expand upon the use of social media in emergency communication?

Which social media tools do you think are the most effective for emergency communication?

For the borough we are working with, can you suggest the best way they can implement social medial tools into their communication system?

What are the best methods to publicize the social media tools to the general population?

Do you have any suggestions of people we could contact to get more information?

We really appreciate you taking the time to answer the questions. They have indeed been useful for our research.

Appendix E: Interview Script – Hounslow's Communications Team

Preamble

Our names are [team members present] and we are a student project team from the United States conducting research in cooperation with the Contingency Planning Unit. We are developing a toolkit of methods to warn and inform the population of Hounslow of foreseeable emergencies. This interview will help us further our research.

Before we begin the interview, we would like to let you know that this interview is voluntary and you may stop the interview or refuse to answer any of the questions at any time. We will be taking notes during the interview if that is okay with you.

Do you mind if we quote any portion of this interview in our report? If you prefer, we can use an anonymous pseudonym. We will send you our paper before it is finalized so you can review the sections in which you are referenced or quoted.

Questions

General

What are the responsibilities of the Communications Team?

How many staff members make up the team?

How involved are you with the emergency notification process?

How do you find out about an emergency?

What process is followed when an emergency warning message must be sent out?

Are there templates or guidelines for creating the message?

What different channels are used to communicate the message?

How do you keep communication with the Control Center?

How do you keep the media updated?

Social Media

How often do you update the social media sites both for non-emergency and emergency purposes?

How do you advertise your social media sites?

Could you provide us with an example of a recent emergency where you used social media?

What are your thoughts about using social media for emergency communication? (e.g. effectiveness, work load, challenges)

Do you monitor Facebook, Twitter, and other outlets of information to see what information the public and media post?

Mass Communication System

Would you please give an overview of the internal mass communication system used in the Council?

Are there any plans on implementing an external system?

If a mass communication system is implemented, who would be in charge of publicizing the system (e.g. getting people to sign up)?

Would you consider a mass communication system as an effective addition to your communication tools?

We really appreciate you taking the time to answer the questions. They have indeed been useful for our research.

Appendix F: Interview Script – Metropolitan Police

Preamble

Our names are [team members present] and we are a student project team from the United States conducting research in cooperation with the Contingency Planning Unit in Hounslow. We are developing a toolkit of methods to warn and inform the population of Hounslow of foreseeable emergencies. This interview will help us further our research.

Before we begin the interview, we would like to let you know that this interview is voluntary and you may stop the interview or refuse to answer any of the questions at any time. We will be taking notes during the interview if that is okay with you.

Do you mind if we quote any portion of this interview in our report? If you prefer, we can use an anonymous pseudonym. We will send you our paper before it is finalized so you can review the sections in which you are referenced or quoted.

Questions

How do you communicate with the CPU and other organizations during an emergency?

What is the process followed to communicate with the public?

Could you expand on the process of creating and delivering the warning message?

Are there any emergencies in which you would not get involved? If so, who would take the lead?

We are aware that you have used Ringmaster as a mass communication system. Do you still use it?

If not, why did you stop using it?

Is there a different system that you use instead, such as Neighbourhood Link?

How does the system work? Do you use it for internal or external purposes or both?

Have you used it during recent emergencies?

How do you get people to sign up for the system?

Do you use social media tools such as Facebook and Twitter during emergencies to push or pull information?

What are the main challenges you have when using these tools?

What initiatives do you take to prepare people for emergencies?

Do you organize any educational programs for schools or the community in general?

Do you work in collaboration with other organizations such as the CPU or the London Fire Brigade to do this?

We really appreciate you taking the time to answer the questions. They have indeed been useful for our research.

Appendix G: Focus Group

Before presenting the toolkit of emergency communication options to the focus group participants, we explained the methodology followed to gather this information. We then proceeded into a discussion of the advantages, disadvantages, and areas of improvement for each of the proposed methods. The following questions helped us gather feedback and suggestions about the applicability and feasibility of each option for Hounslow.

- Has this method been attempted before?
- If so, why did you stop using it?
- Are there other advantages and/or disadvantages that we have not acknowledged?
- What potential issues could arise when implementing this method?
- Would you consider it beneficial for the borough?

In addition, we discussed the criteria that we used to evaluate each method. These included cost, workload, audience reach, timeliness, and geo-targeting.