WPI

Natural Disaster Preparedness

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Natural Disaster Preparedness

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Abstract

Climate change is a globally intensifying threat to the world, accompanied by a worsening level and rate of natural disasters such as hurricanes, droughts, and wildfires. To mitigate the effects of increasing natural disasters, individual disaster preparedness is important. This project investigated individual preparedness in the areas of Iceland and the United States and discovered how organizations in disaster prone areas are preparing their populations. We found that most people are confident in their own preparedness, yet their actual preparations are incomplete when compared to professional advice. We prototyped an application to inform the public of how they should be preparing for disaster and recommend further development of similar resources.

Executive Summary

Climate change is the generation-defining catastrophe, and will only continue to devastate the world as the globe warms at an accelerating rate. One of the most dangerous effects of global warming is an increased rate of natural disasters, especially flooding, hurricanes, and wildfires (Allan et al., 2021). The effects of climate change are now inevitable (Allan et al., 2021). The world must adapt to the reality of increasingly devastating natural disasters, the threat of which can be addressed in a myriad of ways. Although the greatest burden in a natural disaster falls to the governments of the world to provide aid and support to those affected, an important part of disaster mitigation is individual preparedness. Therefore, an effective way to prevent the worst effects of natural disasters is to categorize levels of preparedness and work to fill in the gaps. The goal of this project was to categorize levels of individual preparedness in Iceland and the United States and use this data to develop an application targeting the areas of improvement in preparedness that were discovered.

Earthquakes and volcanoes are natural phenomena, the effects of which range from unnoticeable to devastatingly destructive, all caused by natural movement of the earth's crust and the magma within (de Boer & Sanders, 2002). Although geological hazards are not affected by climate change, the potential for destruction that they pose is similar in nature to the hurricanes and other disasters that will increase in scale due to climate change. Therefore, these area's organizations and programs should be reviewed and adapted to locations that will need them in the future. Places like California and Iceland experience frequent earthquakes or dangerous geological activity and have robust organizations to prevent the worst of these disasters. Iceland itself is a complex microcosm of geological activity, as it is a volcanic island that formed on both a fault line and a magmatic hot spot, leading to a high frequency of both earthquakes and volcanic eruptions (de Boer & Sanders, 2002, p.110). Organizations with high levels of experience with destructive natural disasters are invaluable resources for the world as a whole.

In order to evaluate individual preparedness, understand what exactly being prepared consists of, and identify any current issues with preparedness, we broke our project down into four objectives. First, we investigated the current level of preparedness in the populations of WPI students, faculty, and staff, as well as a general Icelandic population. In order to gather data from these groups we distributed surveys through school organizations and in person canvassing at universities in Iceland shown in Figure 5. These surveys consisted of questions targeted towards the respondents' perception of their preparedness, as well as questions that revealed how prepared they actually were, allowing us to determine what gaps exist in an average individual's ability to respond to a disaster. Next, we investigated organizations in Iceland who prepare and respond to active natural disasters. We interviewed the government organizations of the Icelandic Meteorological Office and the Department of Civil Protection, shown in Figure 7, and researched recent eruptions, gaining further insight into the way the Icelandic government reacts to a disaster as well as the manner in which they prepare their population. Expanding our research further, we interviewed the City of Worcester's Emergency Management division, allowing us to compare the Icelandic government to other organizations

Figure 5: *University of Iceland,* Photo of Main Building at University of Iceland in Reykjavik

Figure 7: *The Department of Civil Protection,* Photo outside of Icelandic Department of Civil Protection in Reykjavik

around the world and gain a fuller understanding of disaster preparedness as a whole. Finally, we used the information gathered to develop an informational application intended to fill in the gaps in current systems and knowledge that we discovered.

Our research into the current levels of preparedness began with investigating the government organizations that have the responsibility of preparing for natural disasters. In order to learn more about their structures and operations, we conducted an interview with each of the previously mentioned organizations. Through these interviews we found that they are a robust set of organizations that were experienced in their ability to respond to a disaster as well as prepare the civilians they serve for natural hazards. Furthermore, we discovered the similarities between the disaster responses of Iceland and Worcester, with both having organizations dedicated to coordinating first responders as well as establishing shelters to aid during and after a disastrous event. This information allowed us to understand the current organizations that oversee disaster response as well as their structures and operations to aid in individual preparedness.

After learning about the basic structure and operations of these organizations, our next finding was about the importance of communication between organizations and the civilians that they serve. We found that trust is of the utmost importance, as these organizations issue important instructions and warnings to protect people during a disaster. If the population does not trust in the communications they are receiving, there is a risk of low compliance with directions or warnings, leading to dangerous situations. Guaranteeing that all communication is both clear and accurate is therefore very important. Similarly important is the ability to understand the makeup of the population communications are targeted towards in order to maintain their efficiency. In particular, immigrant populations are of specific concern, as these organizations have found that they are frequently extremely tight knit and insular communities that listen to little outside information. The solution to this issue goes back to the root of the problem, as getting a trusted voice in the community to aid in communication will allow the message to spread quickly through the close group.

In conclusion, in order to prepare efficiently for a disaster, trust between the government and civilians must be considered in all communications, an effort which the organizations we interviewed constantly consider in their operations.

Next we learned that a majority of people currently believe that they are prepared for a natural disaster. Our surveys revealed that, when questioned about how prepared they currently felt for a disaster, 70% of WPI respondents claimed they were prepared and 80% of Icelandic respondents made the same claim. Although this data says nothing about how individuals are prepared, it is clear that the majority of people at least feel that they are prepared for disaster. Through further research we compiled a set of guidelines to follow in order to actually prepare for a disaster. Our previous interviews offered us a base level of knowledge about the issue, with multiple sources suggesting disaster kits with appropriate supplies. Of particular importance was a three day supply of food and water, survival equipment such as flashlights and communication devices, and household supplies such as toiletries and medication. In addition to our interviews, research into the Centers for Disease Control, the Federal Emergency Management Agency, and the Red Cross allowed us to round out the list of supplies that are recommended for a disaster kit. Also of importance was the information we received from our interviews about informational preparedness. Our sources stressed the importance of, on an individual level, taking stock of both an area's possible dangers as well as the government systems in place such as evacuation resources that exist to aid civilians. Therefore, true preparation for disaster includes both survival supplies and knowledge of ways to react to a disaster.

Finally, when comparing the rest of the results from our survey to the previous two findings, we uncovered a disconnect between actual and perceived levels of preparedness. Despite relatively high levels of perceived disaster preparedness, when questioned about access to basic supplies such as food and water stores, the number of respondents who felt confident in their preparedness was much lower. Similar results were gained from questions about access to survival equipment and household supplies. Even worse were the results from questions about knowledge of evacuation routes and shelters. In conclusion, a clear disconnect exists between feelings of preparedness and actual levels of

preparedness, showing an obvious gap in individual preparedness levels, shown in Figure 10.

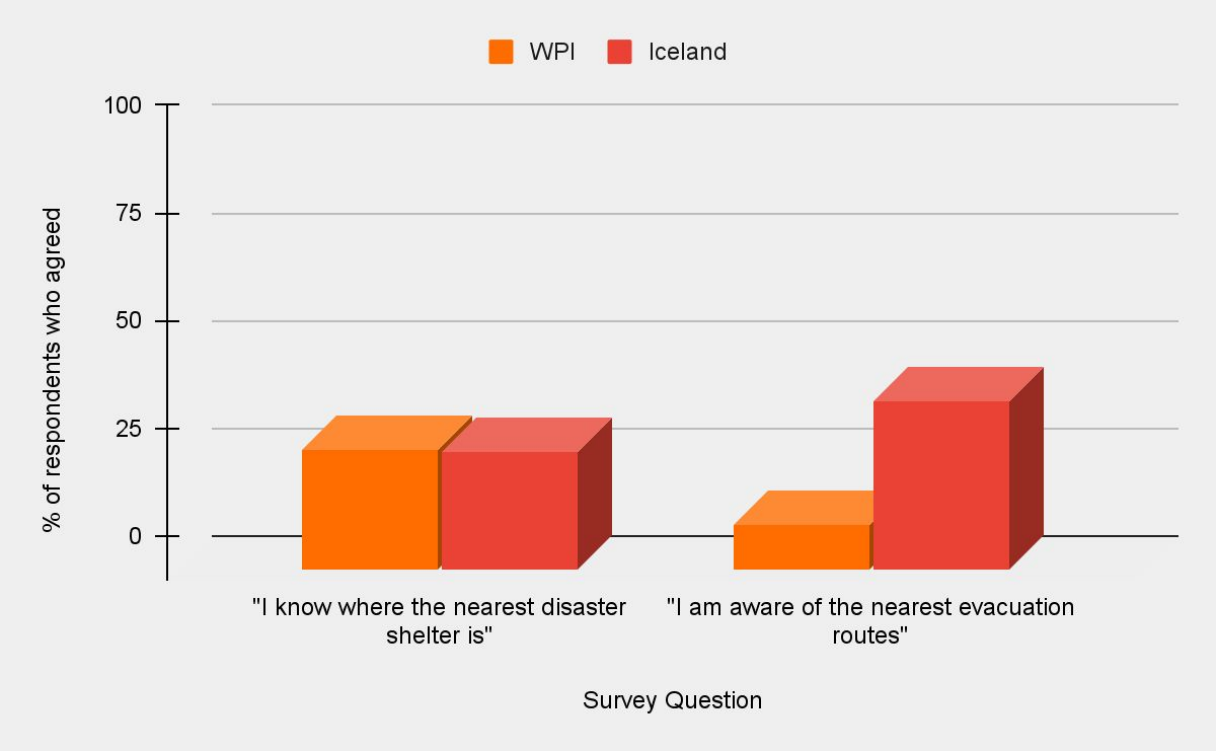

Figure 10: *Questions about Disaster Preparedness Knowledge,* Survey responses to questions "I know where the nearest disaster shelter is" and "I am aware of the nearest evacuation routes" from WPI and Icelandic populations

Throughout our research, we discovered a multitude of resources that are in place to help prepare people for disaster, as well as aid them during an active disaster. Government organizations are the most important of these resources, and they are well equipped to handle disasters as well as outreach and communication with civilians, granted that they build a trusting relationship with those that they serve. However, despite these systems in place, there is a disconnect between actual and perceived levels of preparedness. This gap is a dangerous issue as overconfidence may lead to becoming completely unprepared for an actual disaster.

Using these discoveries, we developed an informational application that selects an area of effect and then displays recommended preparations for disaster in the area. We believe that this tool could be expanded on to allow for further levels of individual preparedness. Finally, we discovered multiple contact points at various disaster agencies that would likely be open to further exploration of projects and would likely be interested in expanding on the issue of individual preparedness.

Authorship

The initials of the main authors and editors to each section are listed in the table below.

Section	Main Author	Main Editor
Chapter 1: A Worldwide threat		
1.1 Disasters in the United States	AO	AC
1.2 Disasters in Iceland	TP	AO
Chapter 2: Methodology		
2.1 Assessing General Preparedness of Citizens	TP	DS
2.2 Role of Icelandic Government Agencies and Other Icelandic Organizations in Natural Disaster Preparedness	DS	TP
2.3 Role of United States Government Agencies and Other Organizations in Natural Disaster Preparedness	AC	DS
2.4 Deliverable	AO	TP
Chapter 3: Findings		
3.1 Organizations exist to prepare people for and aid people during a disaster.	DS	AO
3.2 In order to be effective, disaster organizations must maintain trust with those they serve.	TP	DS
3.3 People are confident in their own level of preparedness.	AO	DS
3.4 Preparation on an individual level consists of both knowledge of disaster risks as well as possession of essential items.	AC	DS
3.5 There is a disconnect between individuals' perceptions of preparedness and actual preparedness levels.	DS	AO
Chapter 4: Recommendations and Limitations		
4.1 Deliverable	AO	AC
4.2 Recommendations	DS	TP
4.3 Limitations	TP	AC
Chapter 5: Conclusion	AO	DS

Meet the Team

Hi I am Trevor Parks. I am a junior Mechanical Engineering major at WPI. While my time in Iceland was short, I tried to record every breathtaking view. I'll never forget the views as I hiked up Fagradalsfjall to see the newly created lava flow.

Hey, I'm Adam Olson, a Biomedical Engineering major at WPI. I was stunned by the breathtaking sights of Iceland, and will forever cherish my memories from there. Working on this project was especially exciting because it gave us excuses to see tons of the terrain that makes Iceland so special.

I am David Sullivan, a junior Architectural Engineer at WPI. I was interested in the Iceland project center for the country's natural beauty and incredible wonders, and I was far from disappointed. My time in Iceland was an incredible and educational experience throughout.

My name is Asa Cooper, and I am a junior Mechanical Engineering major at WPI. I will always remember seeing the northern lights with the other groups in the cohort, which was among many memories from this trip that made the IQP experience a once in a lifetime opportunity.

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1

A Worldwide Threat

1. A Worldwide Threat

Global warming has presented itself as the greatest threat to humanity in modern times. Each of the last four decades have been warmer than the preceding and global emissions show no signs of decreasing at the steep rate necessary to prevent the worst outcomes (Allan et al., 2021). "Climate change is widespread, rapid and intensifying." (Allan et al., 2021). One of the greatest dangers of climate change is its effect on both the frequency and severity of natural disasters (Allan et al., 2021). A perfect example is the East Coast of the United States, which has experienced devastating hurricanes at an increasing rate, the cause of which is highly likely to be attributed to climate change (Emanuel, 2011). Figure 1 shows the increasing rate of hurricanes in the North Atlantic.

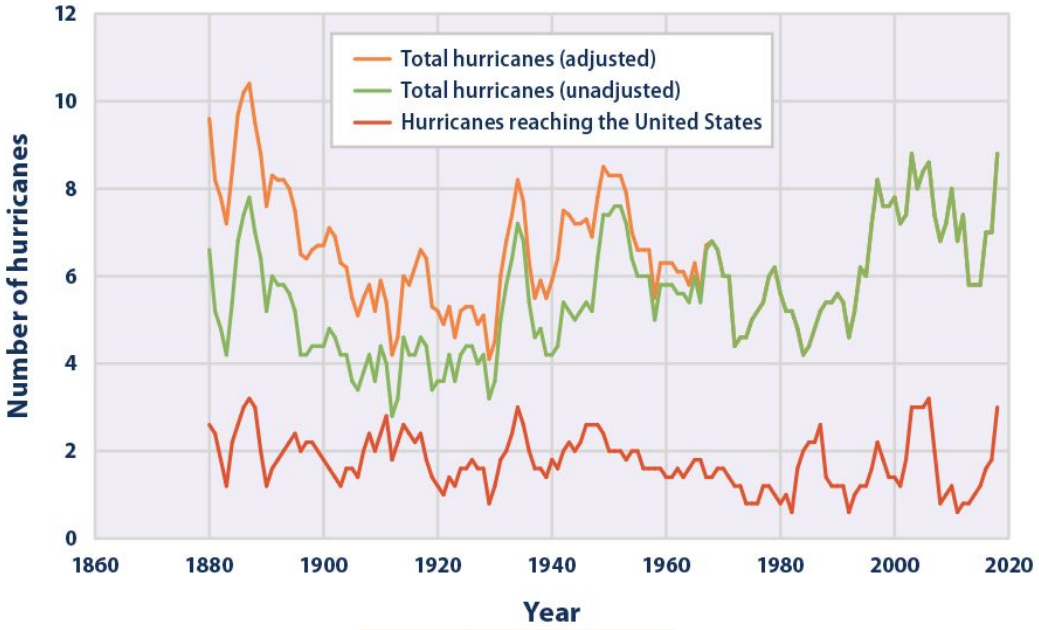


Figure 1: *Number of Hurricanes in the North Atlantic, 1878-2020,* Orange curve accounts for green curve's lack of satellite and aircraft observation in early years. (EPA, 2021)

The entire world will be affected by the effects of worsening climate change, as flooding, droughts, and tropical storms become greater threats as time goes on. Thus, disaster preparedness will progressively become more relevant to society as a whole as both the severity and frequency of natural disasters increase due to the rapid progression of climate change. The goal of this study was to evaluate disaster preparedness and aid and suggest improvements to these methods for individuals and families. The following background research explains further the threat of natural disasters, and the importance of preparation for them.

1.1 Disasters In the United States

Natural disasters have the ability to devastate communities whether prepared or not. This chapter of literature focuses on specific cases from the United States to exemplify what specific natural disasters entail and how support, preparation, and aid can mitigate the impairments imposed by these events.

The state of California is extremely susceptible to many natural disasters due to its geography. There are close to 16 thousand faults in California, which results in many earthquakes in the state (California Residential, 2021). Since the summer of 2019, the California Earthquake Authority, also referred to as the CEA, has reported seven earthquakes close to or above a magnitude of 5 (California Earthquake, 2021). Magnitude five earthquakes have the ability to cause damage to structures and buildings, as well as cause unsecured items or furniture to fall which can also lead to injury or more damage. The CEA also reports that not only do a majority of Californians live within 30 miles of a major fault but also nearly all of the state's regions are at risk of experiencing an earthquake with a magnitude of seven or greater as shown in Figure 2.

Figure 2: *California Earthquake Statistics,* Earthquake statistics from the California Earthquake Authority (California Earthquake, 2021)

In July of 2019, the Ridgecrest region experienced two earthquakes on back-to-back days with the first having a magnitude of 6.4 and the following having a magnitude of 7.1, with resulting aftershocks reaching magnitudes as high as 5.5 (California Earthquake, 2021). Earthquakes of this magnitude and at this frequency require significant aid and preparedness to keep the general population as safe as possible. The state of California has many services, both government and non-profit organizations, which have been designed for preparing or informing individuals about their local vulnerabilities to natural disasters. These organizations included The California Earthquake Authority, The State Governor's Office of Emergency Services, and the California Residential Mitigation Program.

Although California offers many resources available to its citizens, a study focusing on disaster preparedness in the country from the Journal of Pediatric Health Care states that many areas lack the resources necessary for disaster preparedness, despite recommendations given by the Federal Office of the Assistant Secretary for Preparedness and Response, leaving vulnerable communities unprepared (Blake, 2018). Many of these communities rely on the aid of volunteer workers who themselves are often unprepared when compared to places such as urban California that have worked with facilities like hospitals and developed plans and drills to use in situations of crisis (Blake, 2018). Leaving cities and towns unprepared for disaster can leave families and communities in dangerous situations that can cause trauma, injury, and death, where preparedness can prevent these results.

1.2 Disasters in Iceland

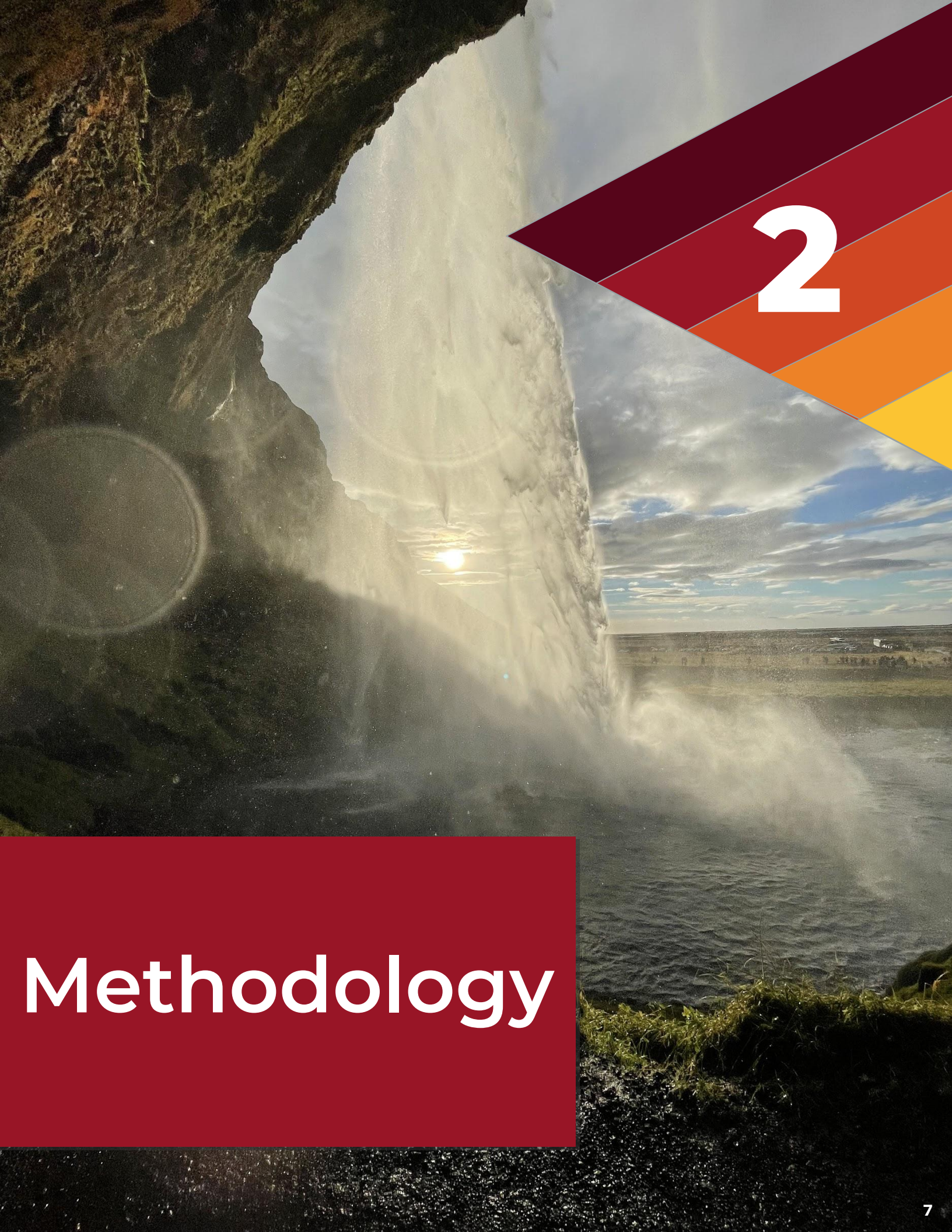
The volcanic nature of Iceland presents relatively constant vulnerability to earthquakes and volcanoes and makes it particularly susceptible to severe flooding caused by glacial melt. Therefore, Iceland provides an example of a country that experienced in disaster preparedness. Iceland is divided by the Mid-Atlantic Ridge, which is the fault line that runs directly down the Atlantic Ocean (de Boer & Sanders, 2002). The part of the fault that runs through Iceland divides the Eurasia plate from the North American plate. These two plates are slowly spreading apart by two centimeters per year (de Boer & Sanders, 2002). The gap made by the spreading of the plates is filled by magma that escapes from volcanoes and fissures (de Boer & Sanders, 2002). Being located on a diverging fault is not in itself unique, however, Iceland is also located a hot spot, which is "the surface manifestation of a plume of magma rises from within the upper part of the Earth's mantle" (de Boer & Sanders, 2002, p. 110) represented in Figure 3. The increase in magmatic activity has led to the creation of the 32 active systems (de Boer & Sanders, 2002, p. 110). These systems are scattered across the country with seven of these systems being located close to Reykjavík, Iceland's largest city (Iceland Meteorological Office, 2021). These fault lines and volcanic systems are sources of natural disasters.

Figure 3: *Iceland's Mantle Plume,* The LAVA centers representation of the magma that forms Iceland's hot spot.

Some volcanic systems have the capacity to create major ash clouds which can be very harmful to people and livestock through fluorine poisoning (Thorvaldsdóttir & Sigbjörnsson, 2015). An example of these ash clouds is best exemplified by the 2010 eruption of Eyjafjallajökull. During this 39-day eruption, 80% of the erupted material was ash, which had a volume of 0.27km^3 and was thrown up to 10km into the sky (Langmann et al., 2012). This caused the "biggest aviation shutdown in history", closing most of the European airspace (Langmann et al., 2012). These volcanic systems and faultlines also have the potential to create earthquakes. Seismic swarms are a series of small earthquakes that have been seen as a precursor to a volcanic eruption; in March of 2021 a minimum of 17,000 seismic events occurred before the eruption of Fagradalsfjall (Desai, 2021).

Not only is Iceland covered with volcanoes, but it is also home to 269 glaciers covering 11% of its landmass (Iceland Meteorological Office, 2021). These glaciers cover some of the volcanic sites in Iceland, and due to the geothermal activity jökulhlaups, or flooding from a glacier-dammed lake, can be caused (Jökulhlaups (U.S. National Park Service), 2018.). These outburst floods can be especially dangerous to settlements, with the potential to cause tsunami-like waves as seen in Figure 4 (Elíasson, 2008). Avalanches and landslides can also be caused by the melting of glaciers. Iceland is a region filled with natural hazards that can be detrimental to those living there without the proper preparation. This project focused on preparedness for natural disasters in Iceland, a country that is extremely susceptible to natural phenomena due to its unique geology.

Figure 4: *Floodwater in Skaftá,* Picture of flooding caused by glacial melt in the Skaftá river (Vatnajokull National Park, 2015)



2

Methodology

2. Methodology

The rising threat of climate change has been accompanied by an increasing rate of natural disasters throughout the world. In order to alleviate the worst effects of the inevitable consequences of global warming, individual preparedness for natural disasters is of utmost importance. The goal of this project was to evaluate and suggest improvements in disaster preparedness on an individual scale. This was completed using the following methods. The preparedness for natural disasters of individuals was assessed by surveying general populations in Iceland and Massachusetts. To collect information on how organizations prepare their target populations for disasters and what resources they provided to do so, we completed semi-structured interviews with organizations that assist in natural disaster preparedness in Iceland. Similarly, we conducted a semi-structured interview with a Massachusetts organization to compare how different locations prepare individuals. We also conducted research into other organizations which help in disaster preparedness in order to fully understand how to provide aid before and during a disaster. Finally, using the collected data we created recommendations that incorporate the best practices from all sources, including prototyping our own application that aids in informing individuals about how to prepare for natural disasters.

2.1 Assessing General Preparedness of Citizens

We first needed to understand the average level of preparation that certain populations have for natural disasters. We surveyed the WPI student body, faculty and staff, Reykjavík University students, University of Iceland students, and the general Icelandic population, garnering 212 WPI responses and 42 Icelandic responses. WPI students, staff, and faculty were surveyed by electronic distribution through various school-affiliated groups such as clubs, Greek organizations, and mailing lists. Icelandic students were surveyed on their campus, as shown in Figure 5. This was done both electronically, by asking students walking to class to scan a QR code that would prompt them with our survey, as well as informally through in-person conversations with locals. The questions were created to allow respondents to answer on a scale from strongly disagree to strongly agree. The questions were phrased this way to allow respondents to give an answer that better reflects their preparedness than that of a simple yes or no. We asked questions targeted at the respondents' perception of their own preparedness, as well as questions that reflected their actual level of preparedness, such as access to emergency supplies and knowledge of disaster shelters. The full list of specific survey questions we used can be found in Appendix A. The surveys provided us with quantitative and qualitative data on people's preparedness, and that data was then used to help accomplish our fourth objective.

Figure 5: *University of Iceland,* Photo of Main Building at University of Iceland in Reykjavik

2.2 Role of Icelandic Government Agencies and Other Icelandic Organizations in Natural Disaster Preparedness

In order to fully comprehend the role of the Icelandic Government in disaster preparedness, our study consisted of research and interviews. The research focused on natural disaster relief organizations and the preparation techniques recommended at an individual level for earthquakes, volcanic activity, and floods. This was used for the framework of information that we provide to citizens at risk of natural disasters in our deliverable. We created interview outlines, found in Appendices B and C, and used the outline for a semi-structured interview with Icelandic authorities. Both the Icelandic Meteorological Office, shown in Figure 6, and the Department of Civil Protection were each interviewed once using these outlines. The interviews offered more in-depth insight into the day-to-day operations of Icelandic governmental bodies as they prepare the population for disaster.

Figure 6: *The Icelandic Meteorological Office*
Photo of the Icelandic Meteorological Office building (Icelandic Meteorological Office, n.d.)

2.3 Role of United States Government Agencies and Other Organizations in Natural Disaster Preparedness

To expand the scope of our project, we investigated the United States in areas with similar disasters to Iceland and the way their populations prepare for these events. In order to complete this objective, we first conducted preliminary research through reputable sources to determine a base level of information on disaster preparedness of similar situations in other parts of the world. This research largely focused on California's earthquakes and similar disasters in the west coast area. Through this research, we investigated organizations such as the Federal Emergency Management Agency, the Center for Disease Control, and the Red Cross due to their many programs created to help improve preparedness in individuals for natural disasters. A semi-structured interview, as outlined in Appendix D, was conducted with the City of Worcester's Emergency Management division in order to get a more in-depth understanding of how organizations help to manage the risk of natural disasters in Massachusetts. Because there was uncertainty early in this project about being to travel elsewhere to collect data, the area's ease of accessibility was a deciding factor in its use. Finally, we used this research to inform our conclusions while creating a deliverable.

2.4 Deliverable

In order to utilize these findings in an effective manner, we gathered our research and results and compiled them to develop a deliverable. To decide on what our possible deliverable would be, we created a decision matrix, as seen in Appendix E, for four different possible deliverables. The four deliverables include a disaster preparedness quiz, a survival infographic, a flow chart to preparedness, and a safety checklist. We chose these options, as they were the most frequent, tangible methods that appeared in our data collection. Each deliverable was scored on a scale of 0-4 under eight categories, with varying multipliers, that we felt were relevant and what we learned to be important to disaster preparedness. The categories and multipliers we used were ease of distribution (x2), reusability (x1), projected impact (x1), ease of production (x0.5), uniqueness (x2), content appeal (x1), design appeal (x1), and ability to be improved (x1). After discussion and scoring, the quiz had the highest score of 23.5 out of a possible 38, followed by the survival flow chart and infographic both with a score of 18.5, and finally the checklist with a score of 15. After examining these results, we decided it was best to use a combination of these options to limit the restrictions of each, while also maximizing the effectiveness of the deliverable. We created an informational application intended to utilize multiple forms of content to address our results. A prototype application was created using MATLAB, a programming language, as well as Piktochart, an online poster/infographic designer. We chose to use Icelandic regions and Massachusetts as examples to show how our deliverable can be used, however, any location could be used with this program with easy edits to the code. Upon use, a user is prompted to select from the eight major regions of Iceland plus the state of Massachusetts. Once selected, general disaster preparedness information is displayed, as well as a region specific infographic. This application was sent to the Department of Civil Protection in Iceland as a recommendation to better prepare Icelanders for disaster. The full recommendation for the usage of this app has been highlighted in chapter 4.1 of this report.

3

Findings

3. Findings

Throughout our research, we discovered the current systems and levels of preparedness, as well as ways that the situation could be improved. First, we found out that there are government organizations currently in place to react to natural disasters, as well as learning how they prepare people for and aid people during a hazardous event. Next, we discovered the importance of the relationships between these organizations and the civilians they serve, with trust being of the utmost importance. Through surveys we found that people believe they are prepared for disasters that could happen to them. Further research revealed the resources, supplies, and information that are necessary to be fully prepared for a disaster. Finally, survey analysis combined with the findings on preparedness resources showed us that despite their confidence in preparedness, many people are underprepared for natural disasters.

3.1 Organizations exist to prepare people for and aid people during a disaster.

Throughout the world, government organizations exist to help aid their citizens through disasters. Although the titles and organization names differ, the scope of many of these organizations, as well as their individual functions, are very similar even across different countries. In order to learn more about the structure and operations of these organizations, we interviewed Dr. Sigrún Karlsdóttir, Director of Natural Hazards at the Icelandic Meteorological Office (IMO), Davíð Lynch, Project Manager, and Ágúst Gylfason, Analytical Geographer at the Department of Civil Protection (DCP), and Diana Rawles, Deputy Director at the City of Worcester's Emergency Management division. Through these interviews, we learned the way governments respond to and prepare for a disaster. In addition, these organizations understand the role that preparedness plays in minimizing harm during a disaster, and have extensive outreach programs to prepare their citizens.

Figure 7: *The Department of Civil Protection,* Photo outside of Icelandic Department of Civil Protection just after our interview

At the Department of Civil Protection, Figure 7, they informed us that before a disaster, the department will issue alerts through traditional media as well as host town hall meetings to directly inform people of the preparations they should make. Similarly, at the City of Worcester's Emergency Management division (WEM) we were informed of Massachusetts' KnowPlanPrepare program that is aimed at preparing civilians for a disaster. A key function of these organizations is predicting hazardous events with accuracy. WEM has their own meteorologists on staff, while in Iceland

the Icelandic Meteorological Office (IMO) functions to support the DCP by predicting natural events as well as categorizing their danger levels, as explained to us by Doctor Sigrún Karlsdóttir, Director of Natural Hazards at the IMO. A key organizational function is their responses during a natural disaster, with both the WEM and the DCP working to coordinate first responders to aid during an event. Both organizations have systems in place that go into effect during a disaster, allowing them to set up command centers to coordinate with local authorities, police, firefighters, the Red Cross, and any other first responders who are active. Finally, these organizations establish shelters for those forced to evacuate as well as operate after a disaster to support those who still require aid in rebuilding. In Worcester, the WEM uses local schools such as Worcester Vocational High School and North High School as shelters during and after a disaster, while the DCP coordinates with the Red Cross to set up triage and establishes its own service centers for aid once a disaster has subsided. These organizations are experienced in disaster preparedness as well as disaster response, and are fully capable in aiding their citizens during a disaster. However, their efforts can only go as far as the trust that people have in the organizations, or otherwise they will be unaware of or willfully ignore their life-saving advice before and during a disaster.

3.2 In order to be effective, disaster organizations must maintain trust with those they serve.

Through these same interviews, we also learned that in order to be effective, disaster organizations must constantly consider the relationship of trust they have with those that they serve. If the people do not trust the information being distributed, any important information may be ignored to dangerous effect. Furthermore, we surveyed both WPI employees and students and a general Icelandic population to understand the level of trust civilians have in institutions related to disaster preparedness.

Both the DCP and the WEM oversee their respective area's emergency alert systems, issuing evacuation orders as well as urgent information directly to any phone with service in a certain geographical area. If trust between civilians and the government is damaged, then potentially life-saving alerts could be ignored by many, causing further harm and destruction. Dr. Karlsdóttir at the IMO stressed the importance of clear and accurate information to us, as she feared that any inaccuracy would tarnish the organization's reputation. One of her biggest concerns was their current method of issuing storm warnings; the IMO breaks Iceland down into 11 different regions to which they issue warnings. However, the concern is that the regions are too broad, and that two towns at opposite ends of a region could experience entirely different weather, eroding the trust they have in the warning system. Both the WEM and DCP voiced similar concerns, stressing to us the importance of maintaining accurate and clear information in order to maintain a trusting relationship with civilians. One point of particular issue results from areas with high immigrant populations, for these organizations have found that these communities are often very insular and secluded, causing difficulty in gaining their trust or distributing information to them. The DCP informed us of a specific example that arose during the 2010 eruption of Eyjafjallajökull which threatened a nearby town. Although the department was successful in informing the population of the town through their normal

methods of media and town halls, they overlooked the nearby meat packaging plant which had drawn a large Polish population to a relatively rural town, causing a failure to inform any of the immigrant population. Worse still, the Polish population was relying entirely on native Polish news sources, which were filled with misinformation and fear over the eruption and contained little to no information about how to prepare for the disaster. However, once the DCP realized their mistake, they hosted town halls targeted specifically at the Polish in the area, and with the help of a local school teacher as an interpreter they regained the immigrants' trust and helped prepare them for the disaster. Diana Rawles also mentioned similar concerns about insular immigrant populations, echoing the same worries as well as mentioning the value of one trusted voice in the community being able to reach essentially everyone in that population. Therefore, all aspects of a population must be considered when attempting to maintain trust with a broad and diverse group of civilians. The sources that we spoke to made it clear that a trusting relationship between the government and its civilians is of the utmost importance in terms of the organization's ability to aid before and during a disaster.

Although we encountered numerous concerns about issues that could arise and damage trust, the disaster organizations have been successful in maintaining a relationship with the civilians they serve. Not only did our interviews make it clear that extreme thought is put into every communication to ensure accuracy and clarity, but also our survey data indicated successful results from the organizations. When asked if they trusted local weather/disaster forecasts, 89.2% of respondents stated that they trusted local resources. Through an informal conversation with an Icelandic native we understood the perspective of someone whose trust in the government is waning. He mentioned that during the recent eruption of Fagradalsfjall that began in March of 2021 the warnings that were issued had begun to erode his trust, as the government was unsure if an eruption would occur and therefore waited until the very last minute to issue concrete warnings once the eruption was guaranteed to occur. Although some have lost trust in the information sources provided to them, support for government disaster organizations is high.

3.3 People are confident in their own level of preparedness.

From our surveys, we learned that most respondents are confident in their levels of preparedness for disaster. Those surveyed at WPI felt that they were prepared for natural disasters; 65.1% of respondents felt that they were adequately prepared, with 7.5% choosing the overprepared option, shown in Figure 8. In our survey to those living in Iceland, the same question resulted in 69.6% of respondents feeling adequately prepared for natural disasters, and 8.7% responding that they are overprepared, as shown in Figure 9. Overall, those surveyed felt that they were prepared for disaster.

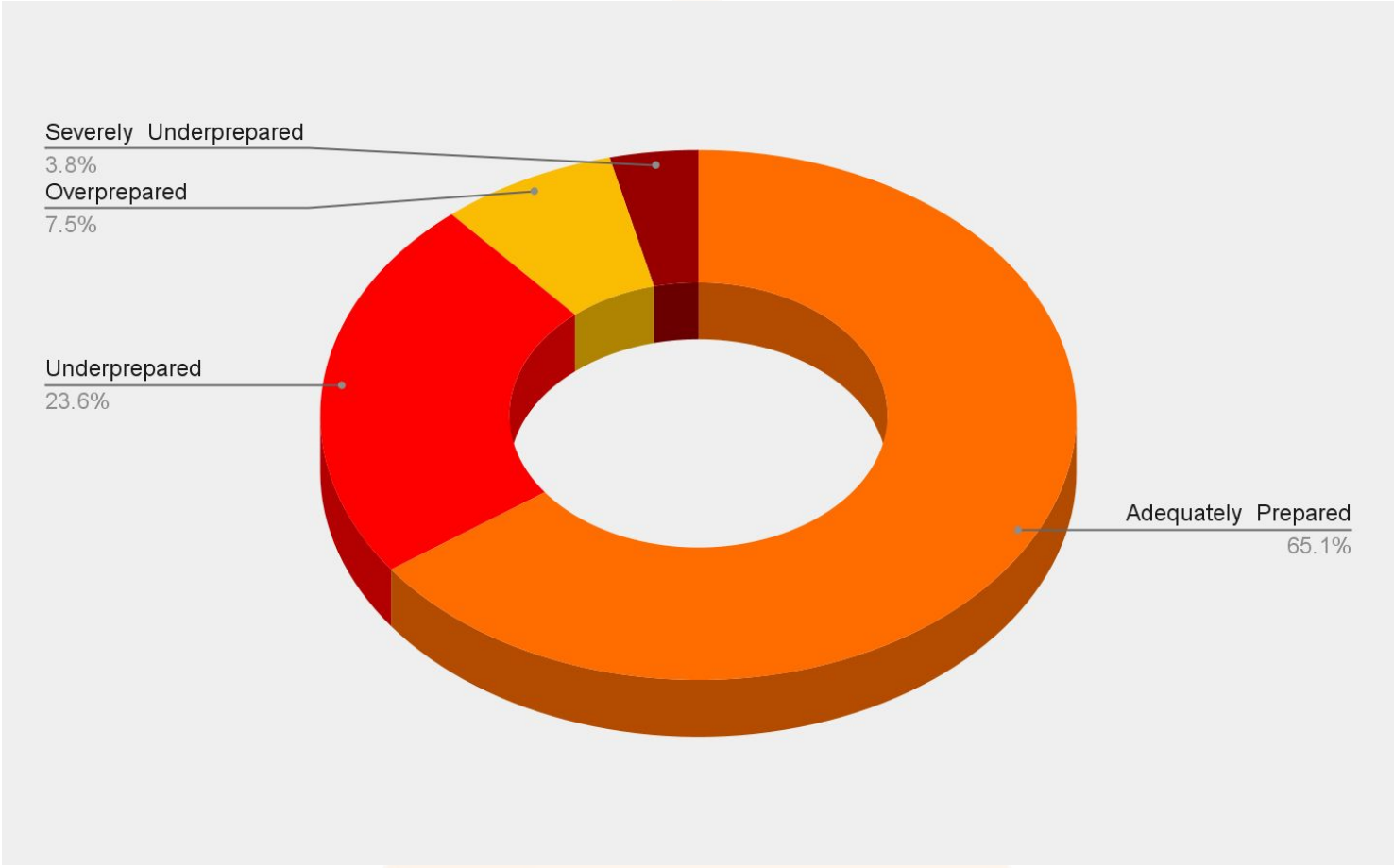


Figure 8: *How Prepared Does WPI Feel for a Natural Disaster?,* Survey responses to question "How prepared do you feel for a natural disaster in your area?" from WPI students, faculty, and staff.

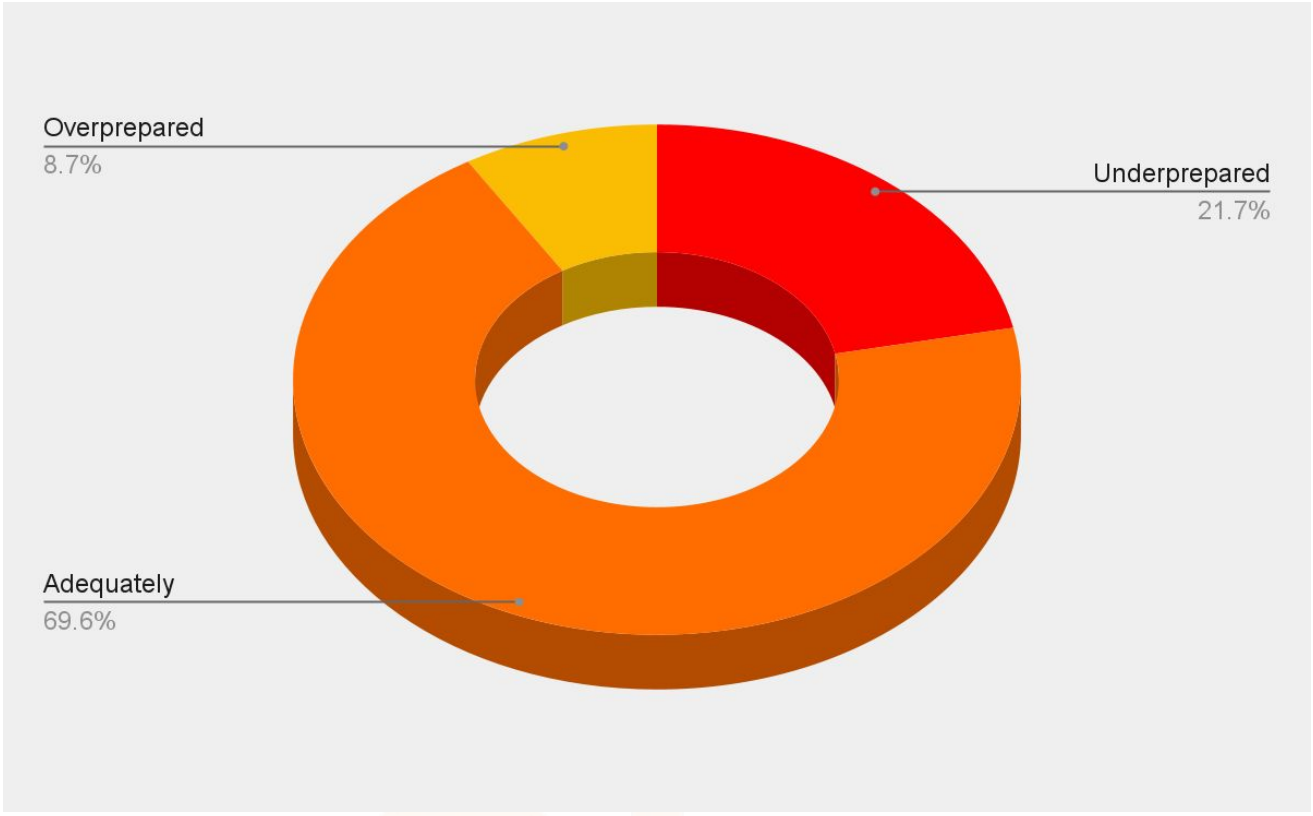


Figure 9: *How Prepared Does Iceland Feel for a Natural Disaster?,* Survey responses to question "How prepared do you feel for a natural disaster in your area?" from general Icelandic population.

3.4 Preparation on an individual level consists of both knowledge of disaster risks and possession of essential items.

Through our research we encountered multiple resources that detailed the information and supplies that are vital in order to prepare for a disaster. Our three interviews all helped to give different perspectives on what is necessary to prepare. In addition, further research into the Federal Emergency Management Agency (FEMA) and the Center for Disease Control (CDC) supplemented our information. These sources all recommend creating some type of pre-disaster survival kit that is ready to go at a moment's notice in case of evacuation. Similarly, these sources also highly recommend preparation for and understanding of an area's specific risks.

One of the most crucial elements of a survival kit is a three day supply of non-perishable food and potable water. The three day guideline was first explained to us by Diana Rawles, who informed us that within three days of a disaster is when the federal and state organizations, such as FEMA, will be able to establish a response in the area and distribute supplies, making the first few days without outside help the most crucial time period to prepare for. Iceland also suggests the same three days worth of food and water, but in their case the Red Cross and the DCP are responding to the disaster. We reviewed the suggested pre-disaster kits of our interviewees and researched organizations and found that a general disaster preparedness kit should include the items and considerations found in Table 1. It includes utility items such as flashlights, multitools, knives, radios, and other survival gear, as well as household objects such as toiletries and medications. Many of our sources provide varying information or specific gear they found important; for example, the CDC focused more on acceptable types of food as well as proper ways of long term food and water storage.

Category	Items/knowledge	Sources
Water	**Preparation** • Filtration system • Boil water before storage • Clean, sturdy, and sealable containers for storage	• Center for Disease Control and Prevention • Department of Civil Protection
Food	**Food criteria** • Long shelf life • Little to no heat required for cooking • No refrigeration needed **Examples** • Canned meats • Canned vegetables • Canned juices • Canned beans • Dried fruit • Nuts • Peanut Butter • Jerky • Granola Bars • Grains **Food preparation tools** • Eating utensils • Cooking utensils • Portable stove • Matches/lighter • Paper plates • Paper cups • Paper towels • Manual can opener	• Center for Disease Control and Prevention • City of Worcester's Emergency Management division • Department of Civil Protection • Red Cross • City of Worcester's Emergency Management division • Center for Disease Control and Prevention • Red Cross
Equipment	• Climate-specific clothing • Pocket/body warmers • Plastic/garbage bags • Emergency toilet • Portable charger • Sanitary wipes • Paper money • Medications • Extra shoes • Toilet paper • Knife • Radio • Helmet • Whistle • Blanket • Toiletries • Batteries • Flashlight • First aid kit	• City of Worcester's Emergency Management division • Red Cross • Federal Emergency Management Agency • Icelandic Meteorological Office
Evacuation items	• Family heirlooms/photos • Debit and credit cards • Social security card • Vehicle registration • Passport • House deed • Birth certificate • Insurance cards	• City of Worcester's Emergency Management division • Red Cross • Icelandic Meteorological Office

Table 1: General disaster kit items and knowledge table with sources

3.5 There is a disconnect between individuals' perceptions of preparedness and actual preparedness levels.

Although the beginning of our survey indicated that people feel prepared for natural disasters, the following questions revealed that many respondents were less prepared than they believed. By comparing the results of our analysis of disaster preparedness items to the results from the rest of the survey, we found that people are underprepared and have only some of the necessary items and knowledge in order to be prepared. The data from across our three surveys indicates a lack of preparedness information in the public. Only 29% of the WPI population were aware of the nearest disaster shelter while in Iceland the result was 27%. Similarly, only 10% of WPI respondents agreed to having knowledge of nearby evacuation routes, while the Icelandic number was higher at 36%, shown in Figure 10. Although this information is highly recommended by experts, it is clear that overall most people are unaware of shelter locations and evacuation routes.

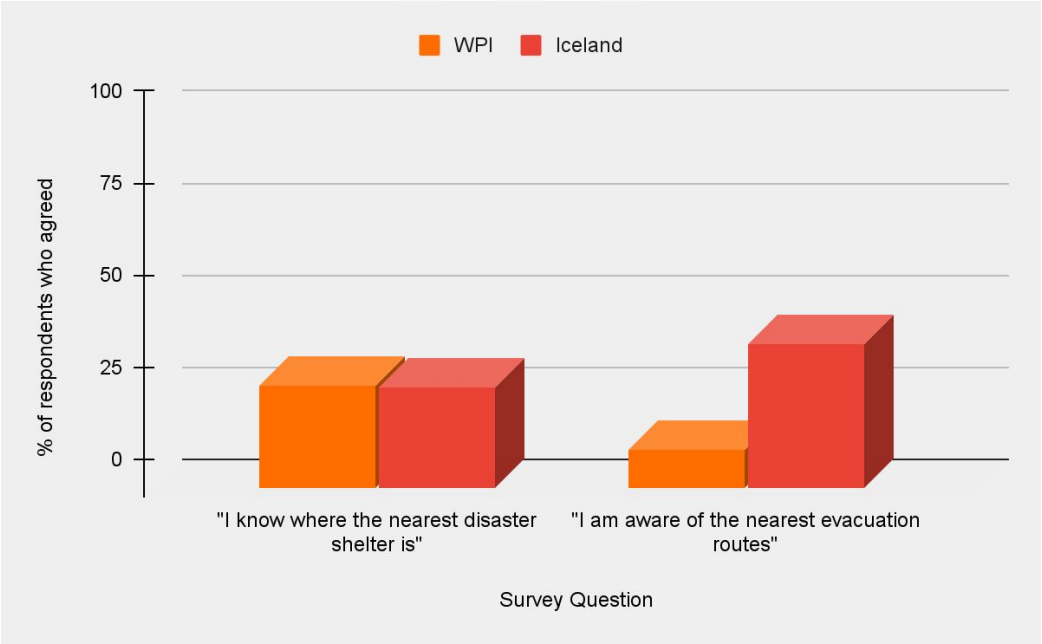


Figure 10: *Questions about Disaster Preparedness Knowledge,* Survey responses to questions "I know where the nearest disaster shelter is" and "I am aware of the nearest evacuation routes" from WPI and Icelandic populations

The section with the most varied results was the questions we asked about possession of specific supplies. We found that people have access to basic household supplies that are also important in a disaster, but the access to supplies that are only necessary in a disaster was lacking. Specifically, 90% of WPI respondents had access to a flashlight and 80% had access to household supplies such as toiletries, extra batteries, and a lighter/matches. The response from Iceland was similar, but only 68% of those surveyed had a flashlight, 71% having extra batteries, and 78% having a lighter/matches. Although these supplies are important in a disaster, they are also common household items that many have access to. The most important supplies, those that are specific to disaster, had a much lower response rate than that of general supplies. In the WPI population, only 45% of respondents had a supply of instant food, and only 35% of total respondents having a portable way to cook said food. The Icelandic response was similar, with 42% saying they have access to instant food and 32% of the overall population possessing a portable way to cook. A full breakdown of these results can be found in Figure 11. Therefore, it is clear that although many have access to basic household supplies that may be helpful in a disaster, they are not prepared specifically for a disaster.

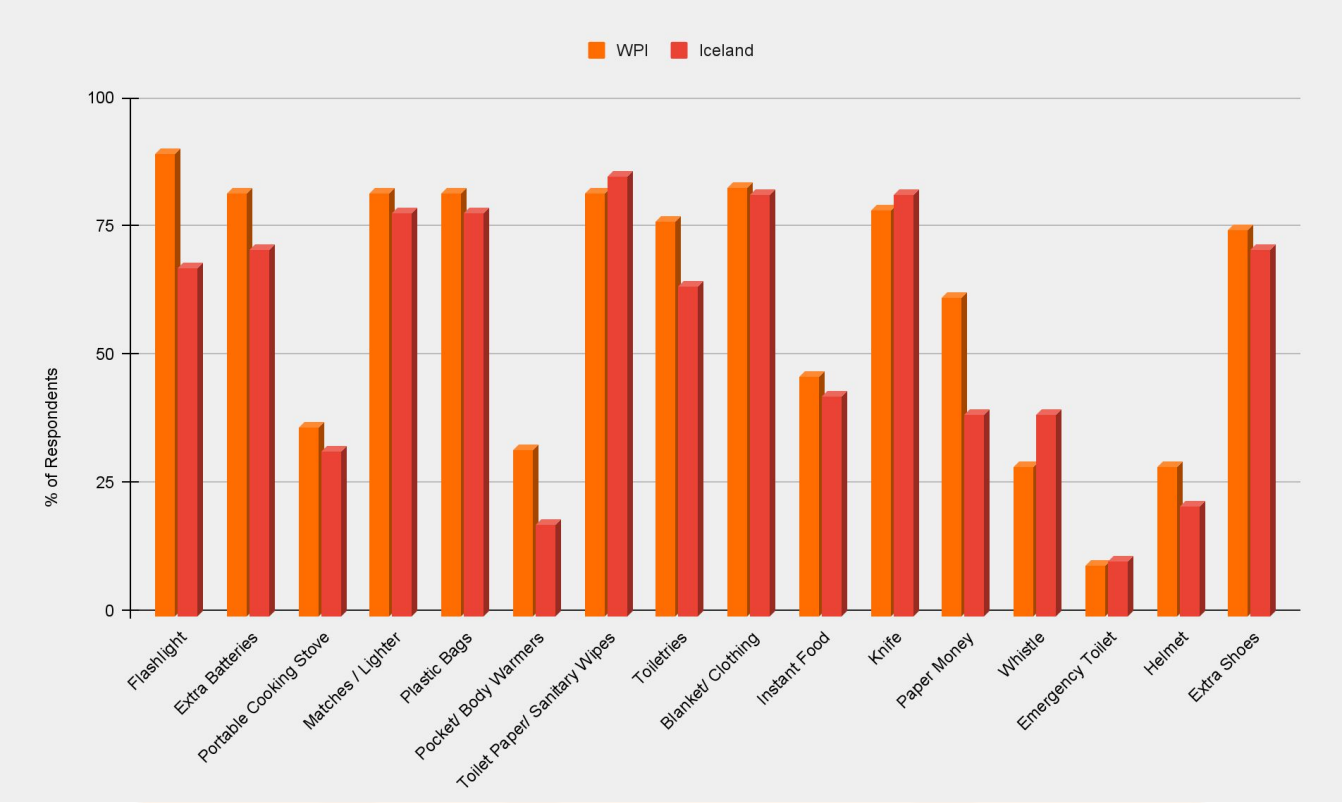


Figure 11: *Equipment Readily Accessible at Home,* Survey result of percent of WPI and Icelandic populations who have listed supplies.

Finally, the disaster preparedness experts we interviewed also suggested easy access to important documents such as identification and insurance information, as well as a supply of any necessary medications. In this regard our respondents were most prepared, with 80% of WPI respondents believing they had their important documents in a safe and accessible location. In Iceland, 67% of respondents felt the same way. Similarly, 75% of WPI respondents and 70% of Icelandic responses had access to their medications, illustrated in Figure 12. Overall, important documentation and medication are important outside of a disaster scenario, resulting in overall high access to both during a disaster.

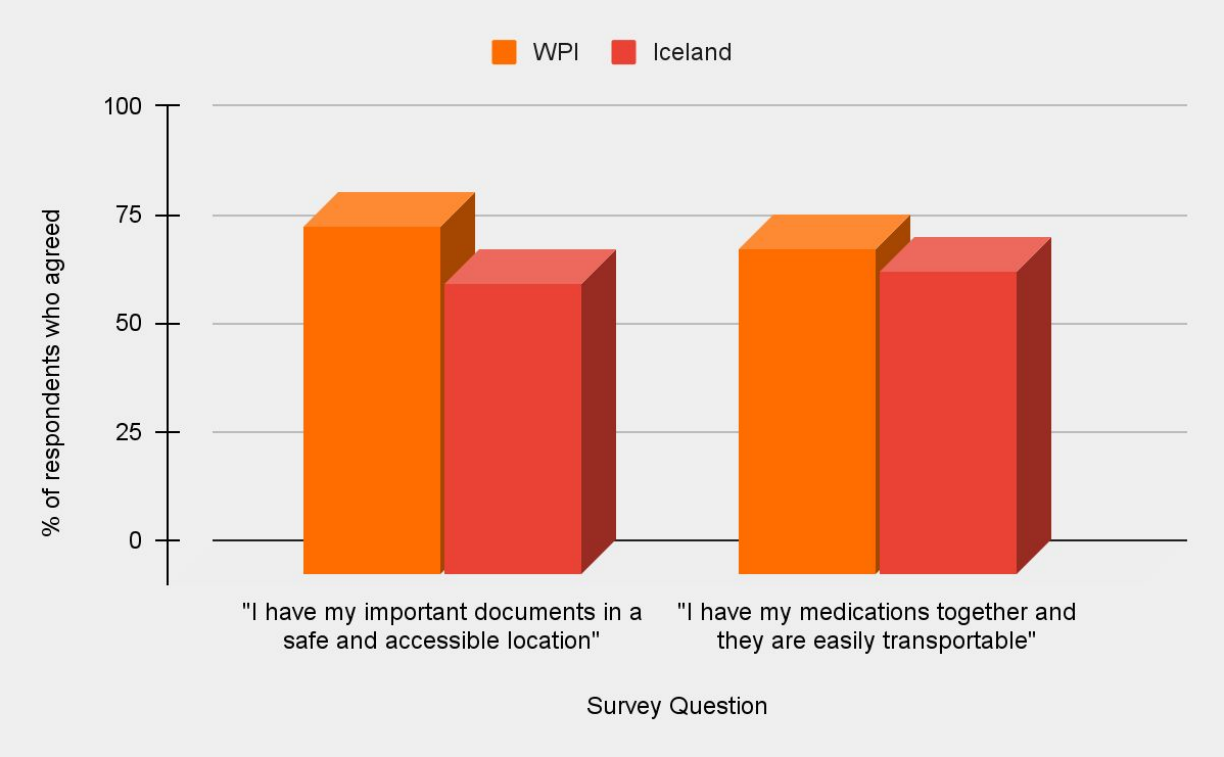
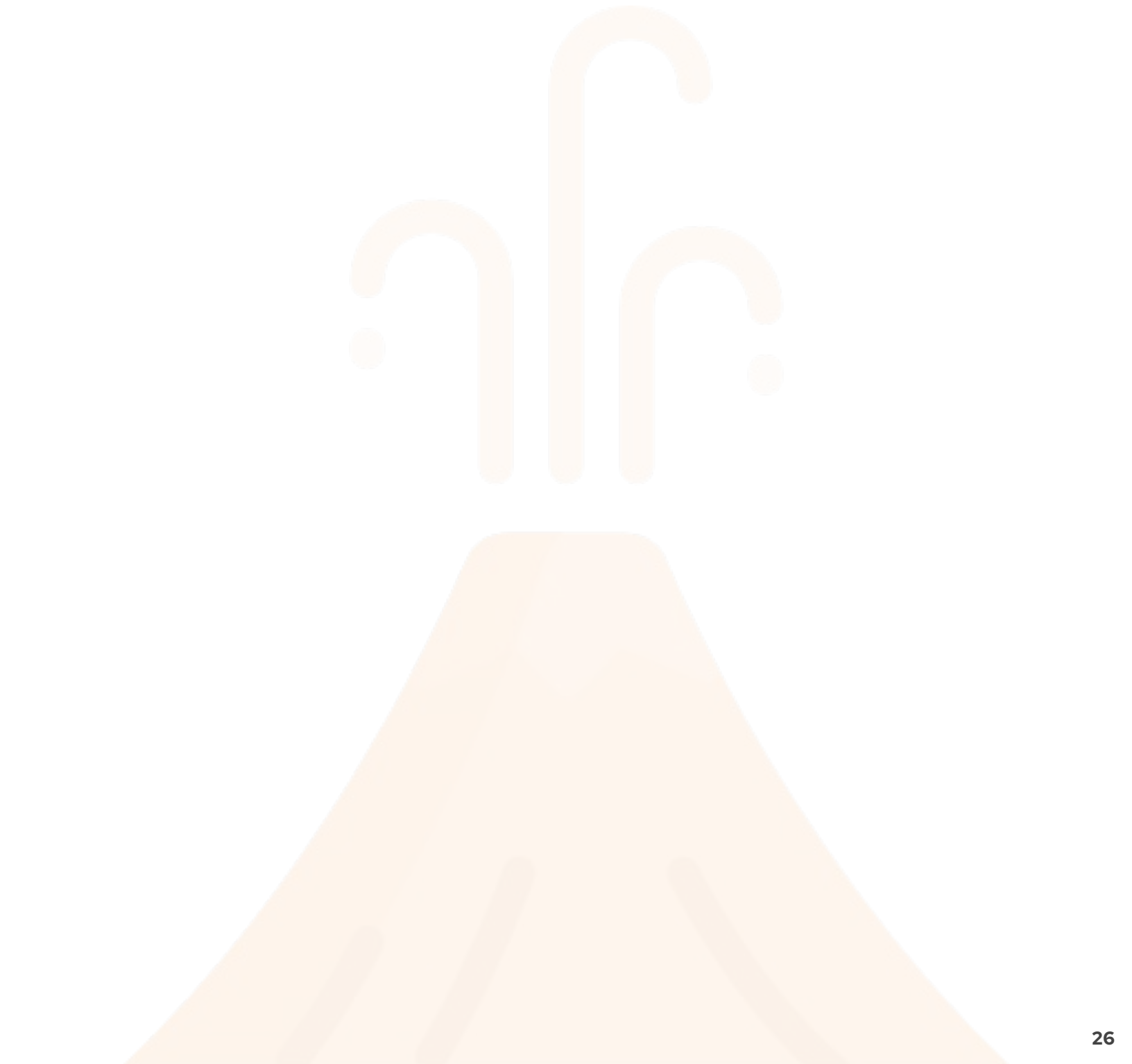


Figure 12: *Questions About Access to Important Items,* Survey responses to questions "I have my important documents in a safe and accessible location" and "I have my medications together and they are easily transportable" from WPI and Icelandic populations.

Conclusively, there is a gap between the amount of people who believe they are prepared for a disaster and those who are actually fully prepared. Although many have access to basic supplies that are useful in everyday life, the most important supplies such as food and water stores are generally lacking. Furthermore, few people know important disaster information such as evacuation routes and shelters. Even during our interview with the Icelandic Meteorological Office, we asked Dr. Karlsdóttir

if she had a kit ready to go in case of an emergency, and she told us she did not. It is clear that many disaster preparedness steps are overlooked or ignored, even though most people feel they are prepared.



4

Recommendations and Limitations

4.1 Deliverable

The final objective for our project was to create an informational application to assist the general public to prepare for natural disasters. We created a prototype that allows an individual to input their location and receive information as well as a checklist of what supplies, procedures, equipment, and other important information are necessary for preparing themselves for the natural disasters in their location. The prototype allows for the selection of one of Iceland's eight major regions, as well as Massachusetts, in order to receive region specific information.

Upon selecting a region, the user is first shown a general infographic that contains important information and resources applicable to all areas. The general infographic has a large amount of information that is imperative to people for preparing themselves for disasters. The goal of this general section is to both inform and provide a list of items that those using the program can review in order to ensure that they are as prepared as possible. The first section of the checklist asks about food and water supplies. Next, the general information overviews what would be beneficial in a preparedness kit. The infographic also discusses general disaster preparedness knowledge, asking questions about if the user knows where to find disaster information, where potential disaster shelters might be located, and if they have knowledge on what potential local disaster relief policies would be. Finally, the checklist summarizes the general information section by asking the user questions about their preparedness plan. The respondent's plan should include providing food, water, and supplies for them and their whole family, including pets, while they are waiting for the bulk of emergency services to arrive, as well as what items would be taken in case of an evacuation.

After the general infographic is displayed, an area specific graphic is next presented to the user, based around the specific region selected. This graphic begins by breaking down the possible disasters in the area as well as the levels of risk that each poses. It also explains any additional equipment or supplies that are necessary for the specific disasters that are a threat. Finally, the

infographic describes the importance of establishing forms of communication between the individual and the agencies that are in place to provide information about natural disasters, as well as detailing the specific communication forms and organizations that exist in the selected region. A downloadable version of this application, with its code file and all files of infographics, can be found at: hhttps://drive.google.com/drive/folders/1e0GbbiOJkmdAQFNOa-BNwVDzBABTX1s2?usp=sharing

An image of our application in use is shown in Figure 13. An example of what appears when selecting the Capital Region can be found in Appendix F.

After the creation of this application and the finalization of this report, it will be shared with the Department of Civil Protection in Iceland, as a recommendation of how to better inform individuals for preparation of natural disasters.

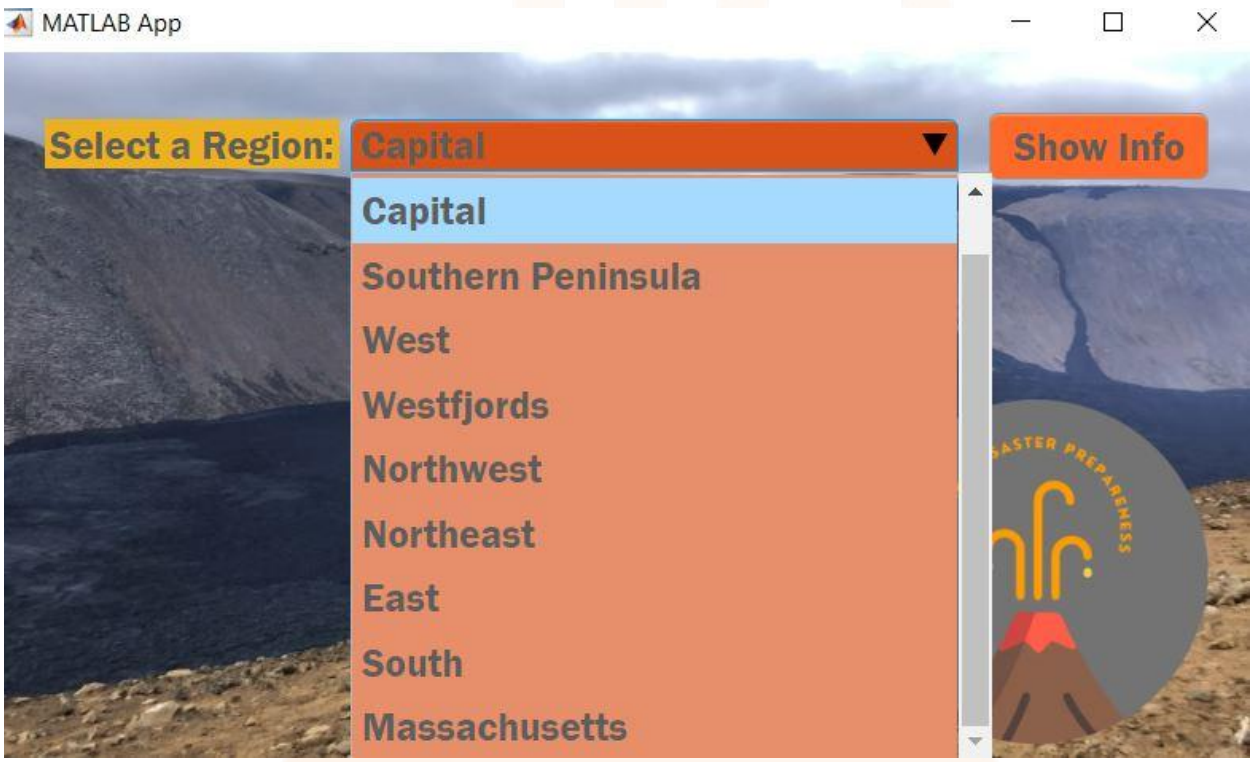


Figure 13: *Informational Application,* Screenshot of our application in use, with drop down menu of selectable regions shown.

4.2 Recommendations

Future groups of students that may follow up on improving disaster preparedness should focus on a specific region or on a specific population. If the Iceland project center wished to continue with our research we suggest focusing on specific regions like the Westfjords, or with populations that are more vulnerable to disasters like those with higher levels of immigration.

Further development of our prototype deliverable would also serve as an effective base for continuing research into disaster preparedness. Currently the program is only adapted to function in different regions of Iceland and Massachusetts, but it could be easily adapted to multiple different areas or even a worldwide scale. Furthermore, the current prototype is rudimentary in its coding and would benefit from expansion to a more sophisticated program or application. Finally, coordination with local experts could allow for specific recommendations that apply to a direct area.

We also have a few organizations that we highly recommend WPI reach out to for future projects, such as the Icelandic Meteorological Office, the Department of Civil Protection and Emergency Management, and the City of Worcester's Emergency Management division, who are all great candidates for future IQP sponsors. The Icelandic Meteorological Office in particular has been working on improving their weather alert map so that they issue alerts more effectively. Currently the IMO divides Iceland into eleven regions to issue weather alerts to. However, the rural nature of many of these regions results in towns in remote areas receiving weather alerts that are not fully applicable. Our contact at the IMO mentioned an intention to break down the regions further, but there is no concrete plan currently, leaving a clear opening for a further project.

4.3 Limitations

In our research, we encountered limitations that impeded our data collection. Our surveys included unclear question formatting that led to less effective results. Many questions were agree-disagree questions that involved choosing one of 5 responses on a scale of strongly disagree to strongly agree. The confusing language occurred in questions asking about personal medications. The statement that respondents had to agree or disagree with was "I have my medications together and they are easily transportable" however, the majority of responses either strongly agree or neither agree nor disagree. This confused us while reviewing the data as to what answer a respondent would select if they did not require medication. If this question were to be recreated, we would add the option of "not applicable" so that the number of respondents that answered strongly agree or neither agree nor disagree would not be skewed.

A question with a similar issue was worded as "Do you have access to water in an emergency?" This caused unclear results as we did not specify if the respondents should include tap water or assume that the sink water is unsafe or unavailable. We then did not know if people are actually prepared with safe water stored as they should have to prepare. Moreover, although many respondents said they had many of the suggested equipment, it is unclear if they have all of this equipment together. This is important to note because although one may have all of this equipment, not having it together does not prepare an individual to be ready in case of an emergency where there is limited time to evacuate. Our data collection results would presumably better reflect the current state of the respondents' water access if this question specified that the water does not include from a tap.

5

Conclusion

5. Conclusion

Although many have a basic level of preparedness, most people are less prepared for a disaster than they believe. Everyone should have a plan in case of an emergency and be able to follow it, including what to do, where to go, and what to take with you. Organizations such as the Icelandic Department of Civil Protection and the City of Worcester's Emergency Management division play critical roles during an emergency to evacuate and aid those who are most affected. They also work to prepare people before an event, sending out emergency alerts and providing information through traditional media sources and community town halls.

For individuals, it is important to know where the nearest evacuation routes are and where the nearest disaster shelters or safe locations are located. Also, individuals should sign up for alternative emergency SMS notifications that are not automatically activated by federal or state emergency protocols. Individuals should also prepare an emergency kit which should be checked and updated every few months so that it is always effective. Included in this kit should be three days worth of food and water, a portable cooker for this food if necessary, possibly a water filter if clean water is not easily accessible, first aid supplies, appropriate clothing for your area, blankets, a flashlight, extra batteries, chargeable or hand-crank radio communication devices, methods of charging these devices, and paper money. More supplies can and should be added depending on an area's vulnerabilities to certain disasters. For example, someone who lives in a location with earthquakes should bring a helmet in case debris falls on them; warmer clothing is similarly important in the case of a blizzard. Some other precautions to take include being sure identification cards, insurance information, and other important documents are in a safe, yet easily accessible area to you such as a safe. Also make sure you have your necessary medications, or at least prescriptions, in an easily accessible location so they can be taken with you in the event of an emergency. Overall, preparedness for a disaster is a crucial step in mitigating the harm that a natural disaster can pose.

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Appendix

Appendix A: Survey

What country do you live in?

If you live in the United States, what state?

Is where you live susceptible to natural disasters? If so, what disasters are most common? Select all that apply.

- [ ] Earthquakes
- [ ] Flooding
- [ ] Volcanic activity
- [ ] Blizzard
- [ ] Tropical storm/ Hurricane
- [ ] Monsoon
- [ ] Tsunamis
- [ ] Wildfires
- [ ] Landslides
- [ ] Avalanches
- [ ] Dust storms
- [ ] Tornado
- [ ] N/A
- [ ] Other

Have you experienced a natural disaster in any form before?

- ○ No
- ○ Yes

How prepared did you feel?

severely underprepared	underprepared	adequately prepared	overprepared	severely overprepared
○	○	○	○	○

Please state whether you agree or disagree with the following statements when at WPI

I know where the nearest disaster shelter is

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have an emergency medical/first aid kit prepared

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have an electric generator for where you live (i.e. apartment or dormitory)

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have a storage of water to use in case of a shortage

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I am aware of the nearest evacuation routes

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my important documents/IDs (passports, visas, registrations, insurance information, etc.) in a safe and secure location that is easily accessible to me

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my medications together and they are easily transportable

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I am aware of the nearest evacuation routes

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my important documents/IDs (passports, visas, registrations, insurance information, etc.) in a safe and secure location that is easily accessible to me

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my medications together and they are easily transportable

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have fully charged communication devices ready for a disaster

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Do you have to following equipment readily available incase of a natural disaster? (select all that apply)

- [ ] Flashlight
- [ ] Extra batteries
- [ ] Portable cooking stove
- [ ] Matches/ lighter
- [ ] Plastic bags
- [ ] Pocket/ body warmers
- [ ] Toilet paper / sanitary wipes
- [ ] Toiletries
- [ ] Blanket/clothing
- [ ] Instant food
- [ ] Knife
- [ ] Paper money
- [ ] Whistle
- [ ] Emergency toilet
- [ ] Helmet
- [ ] Extra shoes

The following statements and questions refer to when you are at HOME

Please state whether you agree or disagree with the following statements when at HOME

I know where the nearest disaster shelter to my home is

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have an emergency medical/first aid kit prepared at home

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have an electric generator for where I live at home

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have a storage of water to use in case of a shortage at home

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I am aware of the nearest evacuation routes to my house

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my important documents/IDs (passports, visas, registrations, insurance information, etc.) in a safe and secure location that is easily accessible to me when I am home

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my medications together and they are easily transportable

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I am aware of the nearest evacuation routes to my house

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my important documents/IDs (passports, visas, registrations, insurance information, etc.) in a safe and secure location that is easily accessible to me when I am home

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have my medications together and they are easily transportable

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

I have fully charged communication devices ready for a disaster

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Do you have to following equipment readily available incase of a natural disaster at your home? (select all that apply)

- [ ] Flashlight
- [ ] Extra batteries
- [ ] Portable cooking stove
- [ ] Matches/ lighter
- [ ] Plastic bags
- [ ] Pocket/ body warmers
- [ ] Toilet paper / sanitary wipes
- [ ] Toiletries
- [ ] Blanket/ extra clothing
- [ ] Instant food
- [ ] Knife
- [ ] Paper money
- [ ] Whistle
- [ ] Emergency toilet
- [ ] Helmet
- [ ] Extra shoes

Appendix B: Icelandic Meteorological Office Interview Guidelines

Hello Dr. Karlsdóttir, thank you for coming. Before we start, we would like to ask you if it would be okay to record this interview so that we can look back to it later.

As you know we are students from Worcester Polytechnic Institute. My name is , (everyone else states their name). We are working on a project to evaluate and suggest improvements in disaster preparedness on an individual scale. And we wanted to ask you a few questions to understand how do Icelanders get prepared

The following questions can be used to guide the interview

- How do you inform Icelandic citizens about disasters?
- What information do you think is most important to tell the general public?
- How do you alert them about impending disasters?
- How do people respond?
- What is the typical procedure for the IMO when a disaster occurs to aid Icelanders?
- How often does the Icelandic meteorological office issue alerts?
- What severity justifies an alert?
- What is the biggest challenge you face when trying to inform or alert the public?
- Do you think that there is any policy or change in policy that could reduce the threat that natural disasters could cause citizens?
- Do you as an individual have any preparations in case of a natural disaster either in-home or in office?
- Is there anyone that you think would be useful to talk to?

Thank you for your time.

If you wish to contact us after this interview you can reach us at gr-EarthquakesIQP@wpi.edu. Please contact us if you have any questions, any further information you wish to share or if you would like to have what information you did provide removed.

Appendix C: Department of Civil Protection Interview Guidelines

Hello Mr. Lynch, thank you for coming. Before we start, we would like to ask you if it would be okay to record this interview so that we can look back to it later.

As you know we are students from Worcester Polytechnic Institute. My name is (everyone else states their name). We are working on a project to evaluate and suggest improvements in disaster preparedness on an individual scale, and we wanted to ask you a few questions to understand how Icelanders get prepared

The following questions can be used to guide the interview

- How do you educate Icelanders on disasters on preparedness?
- Do you find that Icelanders are prepared for most natural disasters that they encounter or do you feel that they are underprepared?
- Could you give any examples of what a lack of preparedness looks like, and what results from that preparedness?
- How do you inform Icelanders, is there a second way?
- What do you feel are the best items to have in a specific disaster?
- What should Icelanders pack in a Preparedness kit?
- Are there any kind of disaster shelters in Iceland?
- What about the more rural regions?
- Do you think the majority of people know about them?
- What is the typical procedure for your department when it is apparent a disaster will occur to aid Icelanders?
- What is the biggest challenge you face when trying to inform or alert the public?
- Do you as an individual have any preparations in case of a natural disaster either in-home or in office?
- What was it like in March of this year when the volcano erupted?
- How did you inform the public?
- How did they respond?
- Was it the response you were hoping for?
- What resources do you have besides alerts that are informative or educational, and what resources do you wish you had that you don't have?
- How long does it take to perform rescue operations anywhere in Iceland?

Thank you for your time.

If you wish to contact us after this interview you can reach us at gr-EarthquakesIQP@wpi.edu. Please contact us if you have any questions, any further information you wish to share or if you would like to have what information you did provide removed.

Appendix D: Worcester Emergency Management Interview Guidelines

Hello Mrs. Rawles, thank you for coming. Before we start, we would like to ask you if it would be okay to record this interview so that we can look back to it later.

As you know we are students from Worcester Polytechnic Institute. My name is, (everyone else states their name). We are working on a project to evaluate and suggest improvements in disaster preparedness on an individual scale. And we wanted to ask you a few questions to understand how do Icelanders get prepared

The following questions can be used to guide the interview

- What is your role in the department?
- How does this department manage emergencies when they arise?
- Do you have any public education programs for the citizens of Worcester? If so, what are they? How do you get information on these public education programs out to the people of Worcester?
- What are key items you should have in a preparedness kit?
- How do you communicate with residents of Worcester on incoming disasters and disaster preparedness information?
- What disaster shelters are there in Worcester? During disasters, are they used?
- Do you believe the general public is informed about the locations of Worcester disaster shelters?
- Do you find that individuals in Worcester are generally prepared for the environmental hazards they encounter?

Thank you for your time.

If you wish to contact us after this interview you can reach us at gr-EarthquakesIQP@wpi.edu. Please contact us if you have any questions, any further information you wish to share or if you would like to have what information you did provide removed.

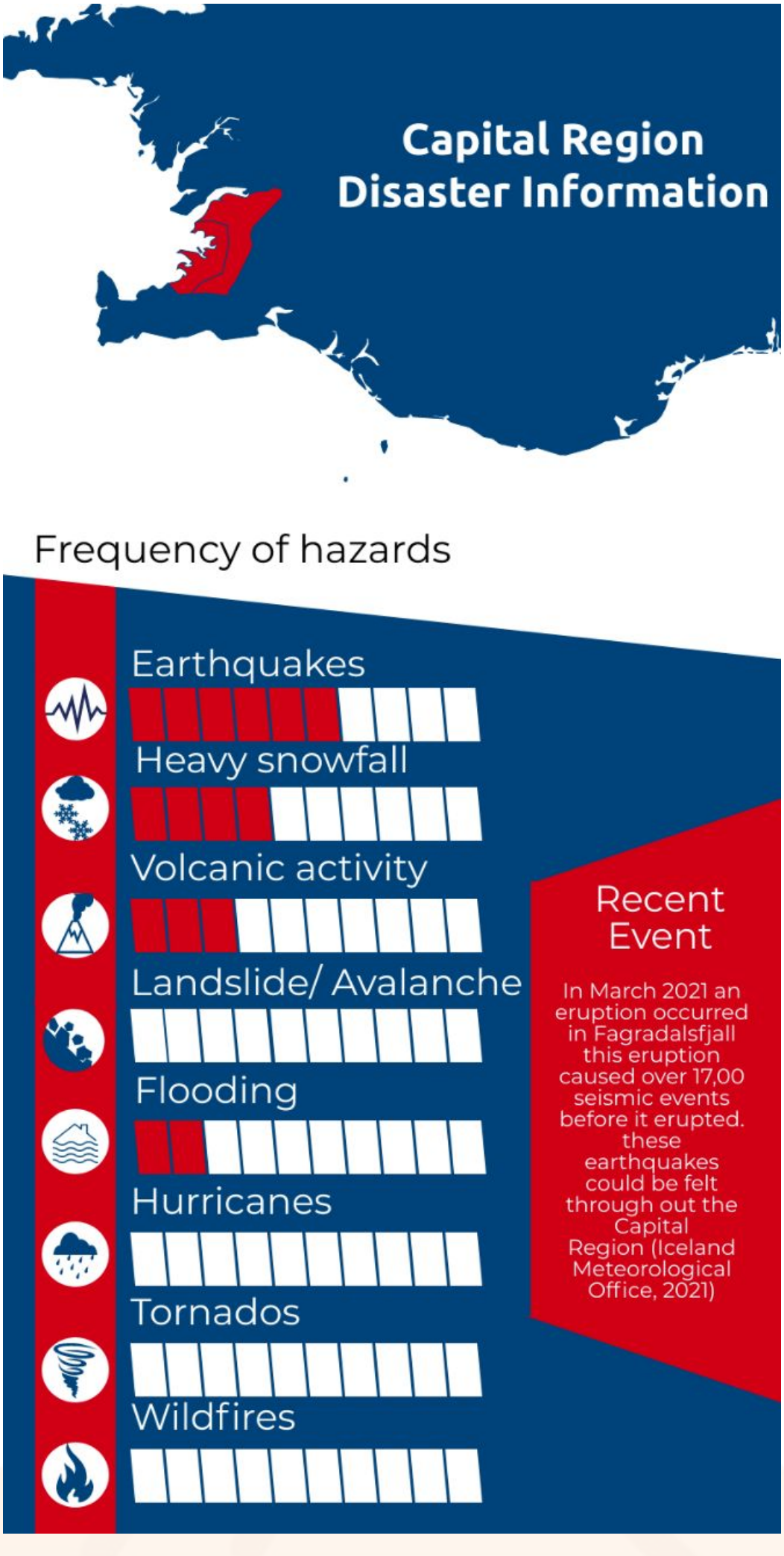
Appendix E: Deliverable Decision Matrix

	Disaster Preparedness Quiz	Survival Infographic	Flow-Chart to Preparedness	Preparation Checklist
Ease of Distribution (x2)	2	6	4	8
Reusability (x1)	1	1	1	1
Projected Impact (x1)	4	2	3	1
Ease of Production (x0.5)	0.5	1.5	1.5	2
Uniqueness (x2)	8	0	4	0
Content Appeal (x1)	4	3	2	1
Design Appeal (x1)	3	4	2	1
Ability to be Improved (x1)	1	1	1	1
Score	23.5	18.5	18.5	15

Appendix F: Example of Informational Application Display

General Infographic

Capital Region Infographic



Get Informed

Information checklist

- [ ] You are aware of the natural disasters that occur in your area
- [ ] You researched how to prepare for disasters in your area
- [ ] You receive disaster and weather alerts from the IMO
- [ ] You are aware of Local relief protocals
- [ ] You are familiar with the locations of local disaster shelters

For the most up to date information on natural hazards and weather alerts see the Icelandic Meteorological Office's Website.

The Department of Civil Protection provides preparation resources to the public.

The Red Cross has multiple shelters and volunteers to help provide disaster relief

This infographic was created by the Natural Disaster Preparedness team for Worcester Polytechnic Institute's Interdisciplinary Qualifying Project.
Contact us at: gr-earthquakesiqp@wpi.edu

Iceland Meteorological Office. (2021, August 20). *Eathquakes in the last 48 hours.* Icelandic Meteorological Office. https://en.vedur.is/earthquakes-and-volcanism/earthquakes