Critical Response and Preparedness for Resilient Futures: Empowering Community Resilience through Two-way Communication Systems in Disaster Zones of British Columbia

By

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1. Acknowledgments

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2. Abstract

Natural disasters not only threaten the safety of individuals and communities but also disrupt the everyday life of people and their means of communication. People are highly alarmed in such situations. They do not know what to do or whom to contact, and wonder if their loved ones are safe; this causes people to depend on real-time information and assistance from each other rather than solely depending on government authorities during a disaster. Communication plays a crucial part in people's survival in such circumstances. Currently, one-way mass notification systems mostly take place in the form of general alerts or warnings. However, people are looking for two-way communication during disasters; they want to be a part of the conversation and the solution. Everyday communication systems like Facebook, Twitter, and Instagram are perfect examples where communities provide information and assist each other and authorities during disasters. However, these do not involve the authorities in the two-way communication problem; multi-level gaps in the current emergency communication system remain.

Aim

To identify opportunities in the mass emergency communication system to help increase the chances of people's safety during natural disasters like fire, flood and landslide in British Columbia.

Research Questions

- How might we design a two-way communication system for communities in disaster zones of British Columbia during mass emergencies like fire, flood, and landslides?
- How might we leverage everyday communication systems that support communities during mass emergencies?
- How might we include communication strategies specific to building Community resilience?

The design solution is based on human-centered design (What Is Human-Centered Design?, n.d.) and system design (Meadows, 2009) methodologies. It aims to understand community needs and communication patterns, build a holistic knowledge of different stakeholder integrated systems, and evaluate the accessibility of the existing communication preparedness plans to design a solution.

The project began by collecting and analyzing data from literature reviews, interviews, surveys, exploratory designs, and workshops to create a list of design principles. It then

utilized these principles to develop a government-based universal information-sharing and community collaboration platform that integrates with Canada's AlertReady system (Government of Canada, 2015).

3. Glossary

- **Communication:** Communication is the exchange of information through verbal or nonverbal means, such as speaking, writing, or other forms of expression, to send and receive ideas, messages, or information between two or more individuals, groups, or other entities.

- **Community:** For this thesis, the word 'community' is defined as a group of people living in and around the disaster zones, and people who have experienced disasters. It also encompasses groups of people willing to volunteer before, during, and after disasters; this includes online communities, safety shelters, disaster support hubs, and more.

- **Community resilience:** A resilient community is able to withstand and recover from disasters; this includes having strong relationships within the community, working together to overcome challenges, and having systems in place to support each other. "Resilience is all about encouraging the building of buffers against future uncertainty." (Coaffee, 2019)

4. Introduction

Thesis Statement
This project identifies shortcomings in current one-way mass emergency alert systems as a means to designing an improved two-way communication platform to help communities prepare for and respond to natural disasters such as fire, flood, and landslide in British Columbia (BC).

According to a United Nations news report, climate and weather-related disasters will increase by up to five times in the next 50 years; furthermore, population growth in disaster zones increases the risk of disaster (Pavlinovic, 2021). Recent disasters in BC, such as Ashcroft Wildfires in 2022 (Gunn, 2022), Abbotsford Floods in 2021 (Schmunk, 2021), and BC

Highway 7 Landslides in 2021 (CBC News, 2021), disrupt the means of communications and safety of people affected.

Communication plays a crucial part in people's survival in such circumstances. In emergencies, challenges include communication traffic, no phone and internet service, late alerts from the government, and low cellphone batteries during disasters. These cause various concerns among people; they do not know what to do or whom to contact and wonder if their loved ones are safe. People outside the disaster zone may also wish to help others but do not know where to start. People depend on two-way real-time information and assistance from each other rather than entirely depending on one-way messages from government authorities.

As challenges exist at the root of community-level communication system and their application, the primary focus of this thesis is to understand the existing system and the demands of the general public from a macro perspective.

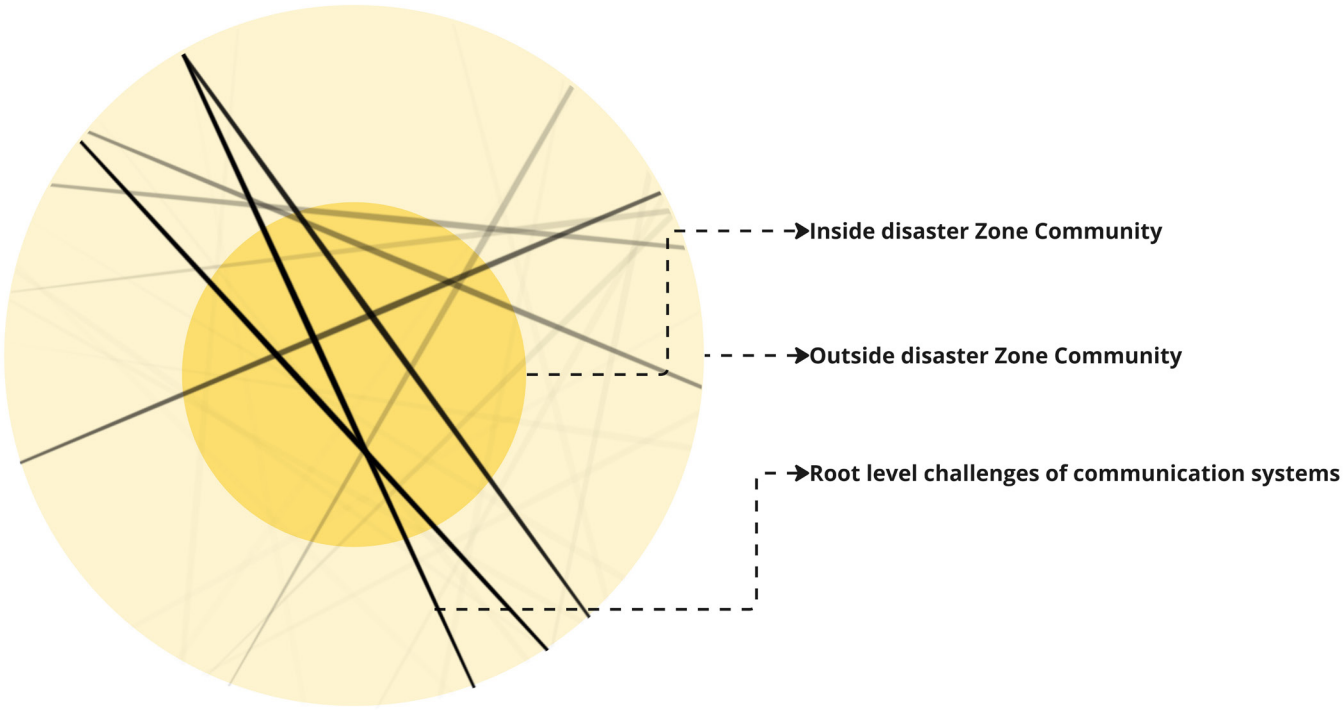

Figure 1: Communication problems within communities.

Drawing upon my experience in the Mumbai floods and past projects, I identified similarities related to disaster communication issues in BC. Hence, I saw a need to continue working towards creating a systemic change through this thesis. It was also

realized that designing communications systems for just one disaster type was not feasible. Instead, it is crucial to have a sustainable solution that works for multiple scenarios and locations to have a greater impact. Therefore, this thesis delves into the interconnected nature of three types of disasters common in BC: fire, flood, and landslide. According to BC's Ministry of Forest, Lands, Natural Resource Operations and Rural Development, "Periodically, British Columbia experiences severe wildfires near populated areas, such as those that occurred in 2003, 2009, 2010, 2015 and 2017. A severe wildfire damages the forest canopy, as well as the smaller plants and soil below the trees. This can result in increased runoff after intense rainfall or a rapid snowmelt, putting homes or other structures below the burned area at risk of localized floods and landslides." (Ministry of Forest, Lands, Natural Resource Operations and Rural Development, BC, n.d.)

Research Questions

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5. Research Methodology

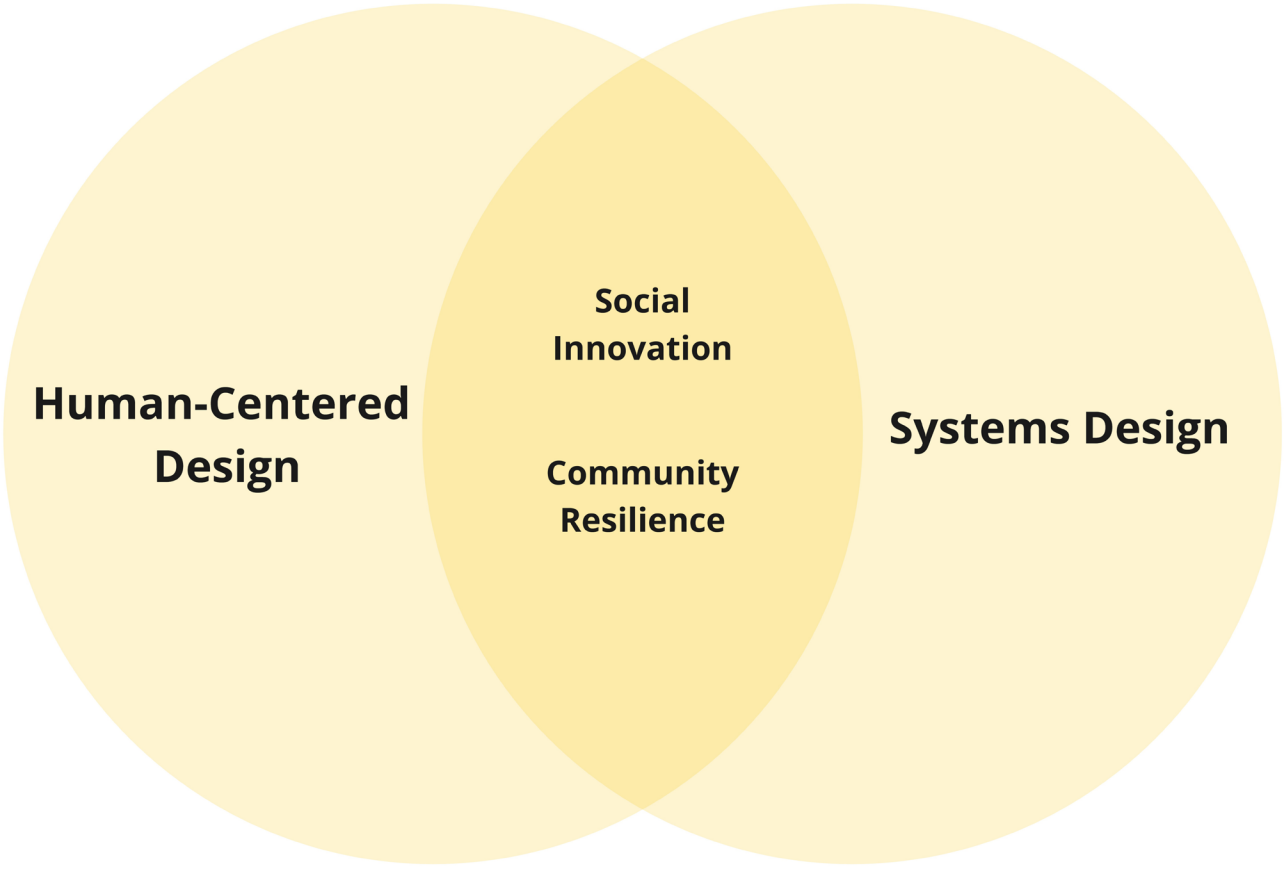


Figure 2: Human-centered design and system design Methodology

Human-Centered Design (HCD)

HCD is a creative approach to problem-solving and designing products, services, processes, and experiences tailored to meet people's needs. HCD is a framework that puts the user at the center of the design process. The user's needs, values, preferences, and barriers are considered to develop desirable, feasible, and viable solutions. An HCD researcher aims to build empathy through stakeholder engagement. "Empathy is the capacity to step into other people's shoes, to understand their lives, and start to solve problems from their perspectives." (Emi Kolawole, cited in IDEO.org, 2015).

Systems Design

The Systems Design approach emphasizes problem-solving by understanding the system's environment and how various components of a system interact. According

to Donella Meadows, components within a system are deeply interconnected, and changes in any component impact the entire system. Therefore, a holistic understanding of the system is required to manage and improve it effectively. By examining the interconnections between system components, rather than looking at its parts in isolation, patterns can be identified, uncover sources of dysfunction, and develop holistic solutions (2009).

HCD and systems design are interconnected; they look at the user experience and how the system can be adapted to meet changing needs. For example, HCD considers components of a system and their use, while Systems Design looks at the needs and limitations of users in order to create a successful solution.

Social Innovation

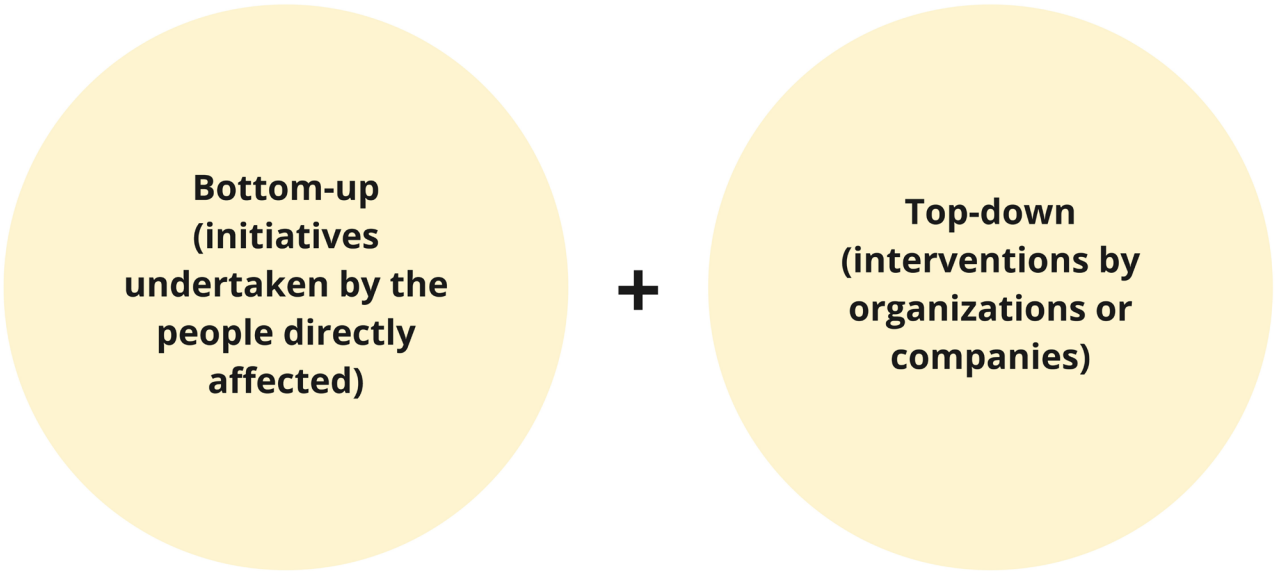


Figure 3: Social innovation 'Hybrid process interaction' approach by Ezio Manzini (Manzini, 2014)

The perspective of this thesis falls under the social innovation spectrum; hence I am trying to attain a 'hybrid process interaction' in my thesis research. Ezio Manzini refers to it as an approach to social innovation that often depends on a combination of bottom-up and top-down approaches (2014); see *Figure 3*. There needs to be a two-way relationship between individuals and organizations to connect communities effectively during disasters. Therefore it is essential to have a holistic view of communication elements, functions, relationships, interconnections, and the purposes involved in the emergency system (Meadows, 2009).

Richard Buchanan, (1992) four orders of design

This thesis project is also strategically positioned within Richard Buchanan's four orders of design, which encompass symbolic and visual communications, material objects, activities and organized service, and complex systems or environments (Buchanan, 1992). These orders provide a framework for understanding the different levels at which design practices operate, ranging from the design of services, information, interactions and experiences to the systemic level that considers the broader implications of design decisions. Furthermore, this thesis aligns itself within the **systemic order of design**, addressing the need for a holistic and comprehensive approach to tackle complex communications and community resilience challenges in the face of a uncertain world (Debaque, 2022; What Do We Mean by Design?, n.d.).

With the help of these approaches, this thesis highlights the importance of examining the interdependence and interconnections of various systems, stakeholders, and contexts in the pursuit of disaster-related social challenges and resilient futures for our communities. This approach goes beyond traditional design practices that focus primarily on the creation of artifacts or isolated solutions. Instead, it emphasizes the need for a critical understanding of the complex relationships and dynamics within the systems in which our communities operate (Debaque, 2022; What Do We Mean by Design?, n.d.). These research methods provide an insight into disaster risk and mitigation at different scales, from individual to organizational levels. It also helps to understand the complexities of disasters and find new ways to build resilience in disaster-affected communities.

Research Objectives

The following objectives provide direction and focus for the thesis research process and form the basis for data collection, analysis, and design outcome. These objectives also help define the scope of the research project.

- To recognize the community and communication patterns seen before, during, and after disasters.
- To understand the response and preparedness of authorities and communities in an emergency.
- To identify information and assistance required by the communities in disaster zones.
- To understand the position of everyday communication products during disasters.
- To analyze people's desire for the future of emergency communication systems.

Methods

The following are the methods considered keeping the research objectives in mind.

Figure 4: Literature Review sources

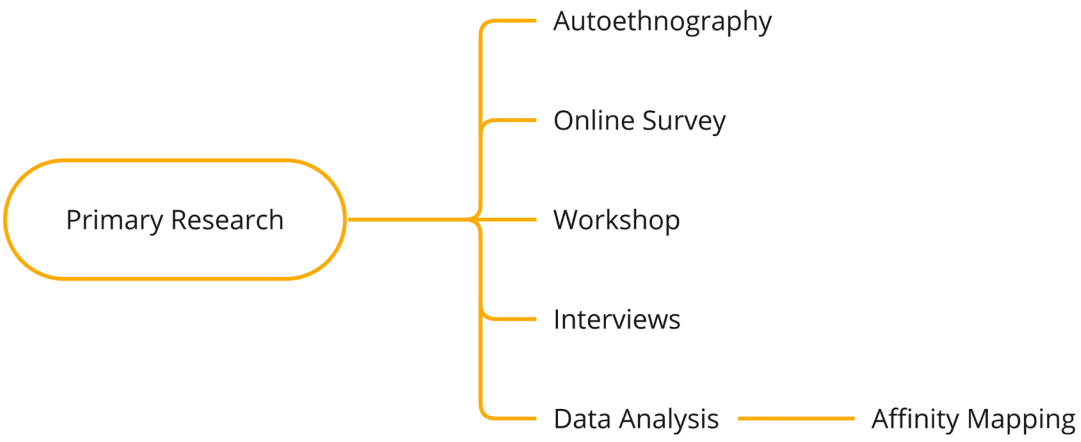


Figure 5: Primary Research Methods

6. Literature Review

6.1. Macro Perspective

This thesis aligns itself with the 11th Sustainable Development Goal, i.e., make cities and human settlements inclusive, safe, resilient, and sustainable (#Envision2030 Goal 11: Sustainable Cities and Communities | United Nations Enable, n.d.). This section reviews the 2030 Disaster Agenda, adopted by the United Nations in 2015. It covers three landmark agreements: the Sendai Framework for Disaster Risk Reduction 2015–2030; Sustainable Development Goals (SDGs) (United Nations, n.d.); and the Paris Agreement on Climate Change (United Nations, n.d.). The United Nations Office for Disaster Risk Reduction - UNDRR (UNDRR, n.d.) works to prevent new and reduce existing disaster risks globally, bringing together governments, partners, civil society, the private sector, and research and academic institutions to create a safer and more sustainable future. They emphasize the importance of community engagement to ensure the success of the 2030 Agenda.

All nations involved in the Sendai Framework agreement is working towards achieving seven targets by 2030 by establishing and following the priority action areas, as shown in *Figure 6* and *Figure 7*, respectively. Keeping Sendai framework's priority of actions in mind, the thesis outcome focuses on two major target points: (1) reducing disaster victims and (2) boosting access to multi-hazard early warning systems and disaster risk information in BC.

Sendai Framework - Seven targets to achieve by 2030
Reduce the number of deaths caused by disasters.
Reduce the number of people affected.
Protect communities from economic loss.
Reduce damage to critical infrastructure and disruption of basic services.
Increase the number of national and local disaster risk reduction strategies.
Work across borders to support developing countries.
Boost access to multi-hazard early warning systems and disaster risk information.

Figure 6: Sendai framework, seven targets to achieve by 2030 (United Nations Office for Disaster Risk Reduction, 2021)

Sendai Framework - Priorities for Action

Priority 1: Understanding disaster risk.
Priority 2: Strengthening disaster risk governance to manage disaster risk.
Priority 3: Investing in disaster risk reduction for resilience.
Priority 4: Enhancing disaster preparedness for effective response, and to build back better in recovery, rehabilitation, and reconstruction.

Figure 7: Sendai framework, Priorities for action (Sendai Framework at a Glance, n.d.)

In 2018, BC became the first province in Canada to adopt the Sendai Framework, which calls for a paradigm shift in the way we manage disasters, with resilience-building as the core goal by 2030. This shift requires the ability to handle present-day issues and vulnerabilities, prepare for potential future disruptions, and capability to work with uncertainty. As per the Special Representative of the UN Secretary-General for Disaster Risk Reduction, Mami Mizutori, resilience means investing in a prosperous future (2019).

Jon Coaffee's book Future Proof, 2019 discusses futureproofing through resilience strategies, which proposes a more collaborative and community-centered approach to dealing with risk and uncertainty. The book explains that resilience is a quality that can vary with different stakeholders. Resilience is about bouncing back to a normal state and bouncing forward to a new normal. It adapts to an ever-changing world and new methodologies to reduce the impact of future events and protect our civilization for generations to come. It is a long-term endeavor requiring difficult decisions and ethical implications and involves using new technologies. Resilience is not a destination but a journey; those who can adapt will survive (2019).

6.2. UNDRR Community of Practice

UNDRR is a multidisciplinary community with an approach that combines both bottom-up initiatives and top-down interventions from directly affected people and organizations/ authorities respectively. Hence, having a holistic view of disaster-affected communities and their communication elements, functions, relationships, interconnections, and the purposes involved in the emergency system is crucial.

Context considerations range from local communities to academic institutions to private and government agencies, where all the participants may exchange their knowledge to co-learn. It is crucial for this community to be inclusive of the plurality required for collaboration to make socially responsible innovations for disaster risk reduction. For emergency communications, people affected by disasters look for two-way communication within and between communities and authorities, during a disaster, as opposed to only one-way information access like alerts & warnings by authorities. This thesis aims to take a step towards systemic change where all are part of the solution.

The community of practice of this thesis and stakeholders involved in disaster risk reduction are depicted in *Figure 8.* It provides a general idea that influenced this thesis and is not an exhaustive list of entities involved in research.

Community of practice & stakeholders in the context of Disaster Risk Reduction

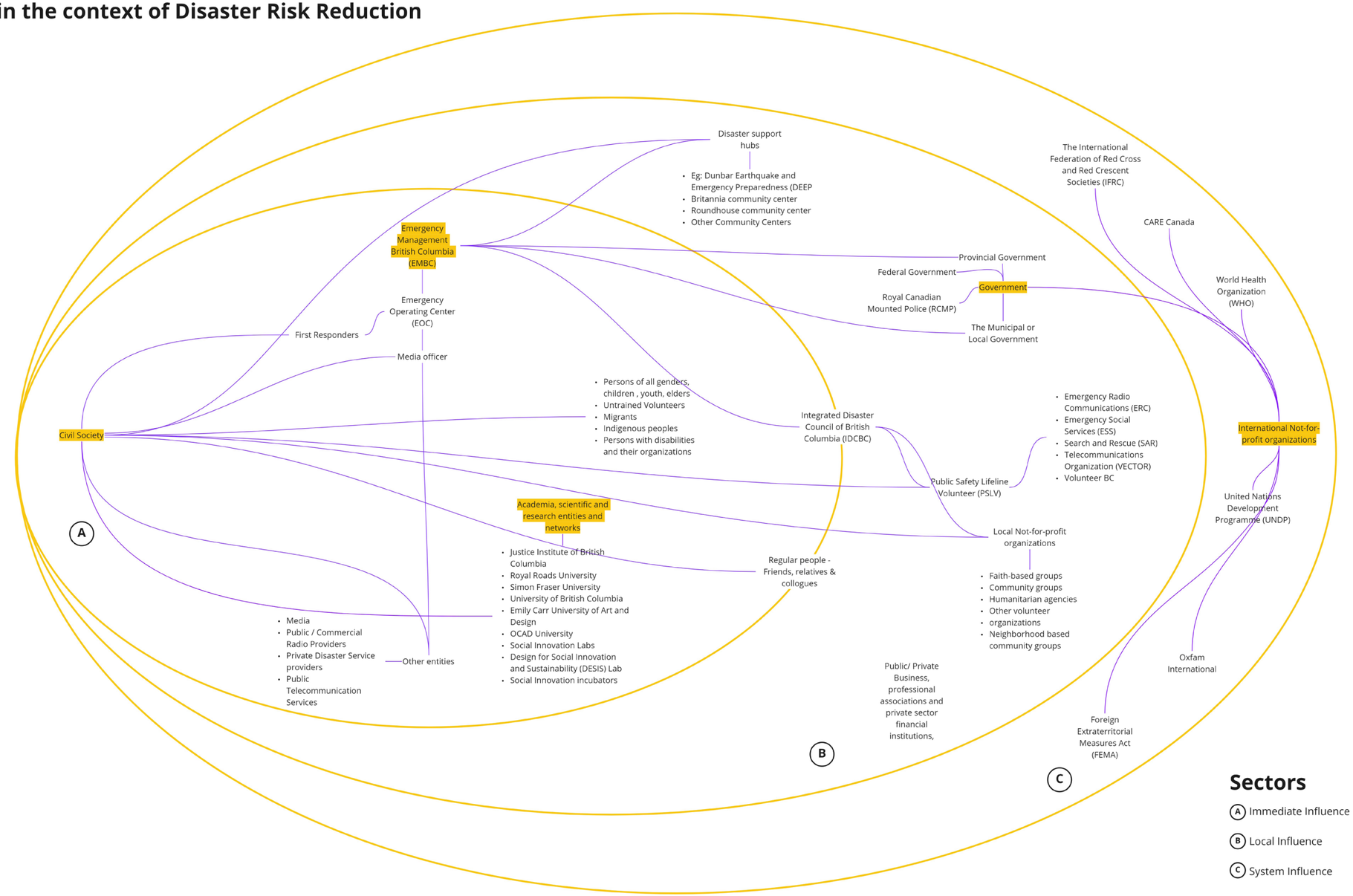


Figure 8: Community of practice and Stakeholders in the context of Disaster Risk Reduction

6.3. British Columbia Context

Emergency communications and alerts in BC

In BC, Emergency alerts get sent out by various organizations depending on the situation. For example, Emergency Management BC (EMBC) distributes alerts for high-risk flood and wildfire evacuations, extreme heat emergencies, and tsunami warnings. The BC RCMP and other local law enforcement entities issues alerts in case of an Amber Alert or a civil emergency, such as an active shooter event. Environment and Climate Change Canada issues alerts during severe weather events, like tornadoes and thunderstorms. These organizations use the Alert Ready system: wireless public alerts (WPA) to issue emergency alerts to TV, radio, cell phones, and other wireless devices (Emergency Management BC, 2022). These alerts are explicitly sent to the disaster warning coverage area to inform the relevant individuals and prevent unnecessary panic in areas outside the disaster zones. For example, Alert Ready System uses the cell tower coverage to target specific locations for alert delivery (Emergency Management BC, 2022).

"...BC began testing Alert Ready in 2018 but was not used in a real situation until 2021, by Vanderhoof RCMP to warn of a shooting rampage in the town centre." (Mackin, 2022). Compared to BC, Alberta used the Alert Ready system 36 times in 2019 for various emergencies such as wildfires, tornados, AMBER alerts, train accidents, and dangerous highway conditions (Mackin, 2022).

The Alert Ready system still needs improvement (McElroy, 2021). A BIV News article highlights that BC emergency alerts were mostly run at the municipality level rather than the provincial level. Causing delays in alerting the people as there are multiple emergencies at multiple locations and a lack of trained people at the municipality level to warn the public (Mackin, 2022). Instead of using 'broadcast intrusive' (BI) alerts, they notified the public about the situation via subscription-based notifications, sirens, door-to-door signage, or social media (Mackin, 2022). However, Public Safety Minister Mike Farnworth said that the province had learned lessons from past experiences and would consider using more emergency alerts in the future (McElroy, 2021).

Furthermore, there is also an Alertable app used by over 1,000 communities in Canada, with a total population of 10,000,000 (Emergency Alerts Software - Our Story - Driven To Make It EASY | PEASI, n.d.). The app is free to download for iOS and Android smartphone users and needs signing in to get the alerts, but has open access to alert information. The app provides users with real-time information about the current emergency, including detailed maps, safety instructions, and access to official news and advisories. The alert

information is passed by agencies or departments authorized to send alerts through Alert Ready System and who have signed up for the Alertable alerting services. The alert information is passed through to the Alertable app without any filtrations. The issuing authority also decides when to send, update, or cancel the alert (Arter, 2018). In addition, individuals customize their preferences of alerts they want to receive through the app, for example, choosing only critical or advisory alerts.

Alert Ready system and the Alertable app are both one-way communication systems, meaning the communities can receive information but not respond. On the other hand, government officials–media managers, private emergency notifiers, and community members use social media like Twitter and Facebook for two-way communications to communicate and pass on information during disaster situations. However, it is important to note that social media has its advantages and disadvantages.

According to a study by the Canadian Red Cross Disaster Management,"... the use of social media contributed to a more efficient exchange of information, improved cooperation between digital volunteers and disaster recovery organizations, and promoted more participation within an environment that made sharing information easy" (Defence Research and Development Canada, 2015). Social media is a powerful tool that can quickly and easily spread information and help reach a larger audience during times of crisis, provided that people have internet access. Unfortunately, it can also be used to spread misinformation, leading to confusion and frustration, and has the potential to cause serious harm. Hence it has become increasingly important to verify the accuracy of the information being shared. A reliable source is essential in order to maintain effective communication and trust. According to Prof. Michael Mehta, "The biggest issue governments and first responders and emergency management organizations faced in 2017 and 2018 was how to put out credible, timely information that gave people the right tools to make decisions, especially when there was misinformation on social media and a lot of contrary information," (Prof. Michael Mehta, quoted in Meissner, 2021).

Reflecting on the above point, two-way communication is the key to ensuring that everyone is on the same page, especially during emergencies, and that any issues can be quickly addressed. This can help ensure that the information is accurate and that the communities and authorities take the necessary steps to address the situation and make informed decisions.

Aside from the communication mediums mentioned above, more diverse systems are available across Canada, depending on the disaster situation. For example, in case

of no-network situations, satellite services on iPhone 14 and Starlink can be utilized by community members during an emergency. There are also portable networks such as Cell on wheels (COWs) and Mobile exchange on wheels (MEOWs) dispatched by government and private organizations for two-way communication. Other than the aforementioned examples, research was carried out on diverse tools and equipment to understand the overall communication systems.

Case Study

1. Abbotsford Floods

In November 2021, Abbotsford communities in British Columbia experienced devastating floods. This flooding caused billions of dollars in damage, and the closure of the US/Canada Border and Highway 1, and disrupted the movement of individuals, goods, and services. In addition, the flooding resulted in extensive livestock and poultry losses and the evacuation of more than 1,100 properties and 3,300 people from their residences. This event drastically affected communities (Flood Response | City of Abbotsford, n.d.). Five people died in what the Insurance Bureau of Canada ranks as BC's most costly weather event, with insured losses of $675 million (B.C. Flood Recovery Tempered by Fears of Looming Climate Disasters, 2022).

The city's public relations response during the flood successfully positioned the city as a trusted source of information, making the city's website a hub for information. They also used social media to drive messaging and partnering with the Abbotsford Police Department for real-time on-the-ground updates and government relations. These efforts reached 380 million views through the BC broadcast coverage (radio and television) and a total publicity value of over $31 million. The city's messaging was also featured in over 2,349 media stories (City Wins National Public Relations Award for Emergency Flood Response | City of Abbotsford, n.d.). However, through a CBC news article, it was seen that communications were slow, and there were delays in early warnings to communities from the authorities; this made the communities question the government's preparedness and recovery plans (McElroy, 2021).

2. South-Central BC Wildfires

The summer of 2017 was a challenging time for the people of South-Cenral BC, as the worst fire season in modern history ravaged the region. Sixty-five thousand people were evacuated.

Claudia Cornwall's book, British Columbia in Flames, Stories from a Blazing Summer, documents the experiences of various community members and authorities and serves as a reminder of the bravery and resilience of the people of British Columbia in the face of such devastation.

The communities came together to help those affected by the fires. For example, a resort owner saved cabins near him and helped ferry contract firefighters to cabins along the lakeshore. Additionally another individual organized a horse community to save hundreds of horses and take them to the Williams Lake Stampede. Furthermore, a woman who was not a police officer worked with a local RCMP officer to help out in the office to evacuate people.

The main communication problems in this situation were related to coordination and communication among the various stakeholders, including first responders, local ranchers, business owners, volunteer firefighters, and the BC Wildfire Service due to the changing conditions of the fire. Communities had to rely on word of mouth, social media, and other systems to spread the news and get assistance. The Caribou Fire Center had to rely on radios and satellite phones to communicate with the firefighters. Complications arose in the form of evacuating people and meeting their needs, as well as a shortage of firefighters and supplies, making it difficult to combat the fires (Cornwall, 2020).

3. Southern BC Landslide

In November 2021, an "atmospheric river" flooded and caused major mud and rock slides in regions of southern British Columbia, trapping families overnight in their vehicles without food or medication, cutting off highways, damaging power lines, and prompting the evacuation of thousands of people. The 7,000 residents of Merritt were evacuated after floodwaters submerged two bridges across the Coldwater River and blocked access to the third bridge. BC Emergency Health Services reported that they had transported nine people with minor injuries to the hospital a night after the landslide near the city of Agassiz.

Hundreds of people found themselves stuck after major routes connecting Metro Vancouver and the Interior were closed, leaving many travelers stranded in locations like Hope with no clear timeline for when people will be able to return home. Many people slept in their cars, while others found refuge in hotels and restaurants. Emergency Management BC used various systems to provide supplies and shelter to the stranded people, including food, water, cots, mattresses, and generators. Local businesses, organizations, and First Nations communities also opened their doors to help those affected. People have shown great kindness and generosity in helping those in need and have managed to make the

best of a difficult situation.

The Canadian Forces Joint Rescue Coordination Center in Victoria, British Columbia, deployed three CH-149 Cormorant helicopters to rescue stranded motorists on Highway 7. This disaster incident was also a strong reminder of the risks posed by climate change. Stranded individuals were cut off from reliable information due to communication issues, such as spotty internet service and lost phone signals in some areas. To get the latest updates, they had to rely on each other and text messages from friends and family. In addition, BC Emergency Health Services used Twitter and other social media to communicate with the people. However, the communities also noted that they were not getting clear instructions from authorities on when they could go home, and the poor internet connection in the area made it hard to get information (Coletta & Parker, 2021; Weisgarber et al., 2021).

Case Study Conclusion

The above examples show that there are various communication problems during disasters, and depending on the disaster and topography of the location, the challenges keep changing. For example, in the Abbotsford floods, the main communication problems were related to the slow communication of early warnings from the authorities. In South-Central BC Wildfires, coordination, and communication among the various stakeholders were the main communication problems. Finally, with the Southern BC Landslide, the phone networks were not working well, and people relied on texts from friends and family to get the latest updates. These examples show how people tackled multiple communication challenges. In all three cases, people had to rely on word of mouth and social media to spread the news and get assistance. Furthermore, people showed great kindness and willingness to help those in need, which is a testament to the resilience of the communities in the face of disasters. Further research into the communication strategies used during disasters could provide more insights into how to better prepare and respond during these events in the future.

6.4. Human behavior during emergencies: Assumptions and reactions

During emergencies, human behavior can be unexpected. It is a common misconception that people panic or become hysterical in emergencies, but in reality, people often respond in both productive and unproductive ways. In the immediate aftermath of a

crisis, it is common for people to feel disbelief, anxiety, fear, and confusion. However, panic and hysteria are not as common as we might think. Instead, people often try to ensure their own safety and welfare, and some also try to help others. This behavior has been observed in numerous emergencies worldwide. Productive responses to emergencies can include increased physical strength, heightened sensory acuity, and faster reaction times, particularly for those trained in emergency response procedures. Unproductive responses may include overreactions or inappropriate actions, or even freezing in the face of action. While most people respond reasonably well to emergencies, their actions may not always be efficient or orderly. In these situations, external structures and systems may be necessary to help guide individuals through the next steps (Crisis Prevention Institute, 2019).

"Regular people only feature into the equation as victims, which is a shame. Because regular people are the most important people at a disaster scene, every time."
(Amanda Ripley cited in Hardister, 2019)

6.5. Information processing and communications

People often react to a disaster based on how the information is transmitted. Following are some of the points to consider.

1. Simple messages
In disaster situations, people often face difficulties understanding and processing information due to high stress, cognitive overload, and biases resulting in inattention, limited retention, and misinterpretation. In addition, this large amount of unorganized data can adversely affect an individual's logical or rational decision-making capacity. This is due to heuristics and impulsive tendencies that might be counterproductive. In order to overcome these challenges, it is vital to deliver concise, clear, and easily understandable messages that enable individuals to prioritize decisions effectively. (CERN, 2019; Maya Shankar, End Well, 2019).

2. Behavioral responses to Information overload
The Protective Action Decision Model (PADM) is a comprehensive framework to analyze how individuals respond to emergency warnings. This model highlights three crucial components: information search, where individuals seek relevant information to better understand the situation; protective response, where they take necessary actions to ensure their safety; and emotion-focused coping, which refers to the strategies used to

manage emotional distress caused by the emergency.

Cognitive limitations in attention, working memory, and long-term memory, along with the differences between concrete experiential and abstract semantic memory systems, influence how individuals process environmental hazard information. In addition, emotions also affect cognitive processes. Therefore, to promote effective and protective responses, warning messages should provide information that assists recipients in understanding the threat, expected time of impact, affected areas, and appropriate safety measures. (Lindell, 2018)

3. The Power of the Messenger

It is essential to be mindful of who conveys the emergency message during a disaster. The entity presented as an expert or authoritative figure can affect how people absorb critical information and the decisions they make, as they may be more likely to trust a familiar face or a known group. It is essential as during an emergency, people may hold firmly onto their beliefs and not be willing to adopt or consider new approaches or perspectives. Additionally, to help ensure the best judgment of people, open communication is necessary to dispel any doubt or speculations. Therefore, it is wise to be transparent about how the government or involved organization came to particular decisions and what processes were employed to make those conclusions. Another critical point is that the messenger should aim to express empathy to individuals who are directly and indirectly affected by disasters and outline what steps can be taken to manage the situation–also, acknowledging the situation's uncertainty allows people to understand the situation better and take necessary precautions. By helping people to navigate the crisis with accurate and actionable information, they can stay vigilant rather than adopting impulsive or potentially harmful behaviors (CERC, 2019; Maya Shankar, End Well, 2019).

4. Consistency

In times of emergency, people tend to rely on firsthand experience when making decisions. Likewise, individuals commonly seek out additional information and different perspectives. For example, people often check social media and switch between television channels to determine whether the warning is repeated and check for confirmation of messages. Also, people may call family and friends to gain further insights and check trusted local leaders for advice. It is common for people to look at neighbors and confirm if they are taking similar action before making a decision. Ultimately, confirmation plays a significant role in how individuals make their final decisions during an emergency; hence consistency in shared infromation is important (CERC, 2019).

5. Fast and reliable messages

When dealing with an emergency, one of the most critical factors in messaging is the quickness of response. Additionally, messages should be recurrent, established by numerous reliable sources, highly relevant to the emergency, and provide a positive action plan. Without such information, people start speculating, and the chances of rumors spreading increase. People often believe the first message they get, even when more accurate information becomes available later. Therefore, when communicating with someone affected by a disaster, subsequent messages should be kept straightforward, viable, and consistent (CERC, 2019).

6. User Agency and Control

People need to feel empowered and in control when it comes to decision-making. When people feel that they are part of something and are able to participate in some important process/safety process, it gives them a sense of ownership. It can be as simple as selecting from the preferences provided by the government or contributing to the community by passing important emergency-related information (CERC, 2019; Maya Shankar, cited in End Well, 2019). This can build a stronger bond with the community as they feel invested in it, leading to a better outcome. In addition, such small changes can significantly impact the system, and by being mindful of these effects, emergency communication professionals can help make a difference (Maya Shankar, cited in End Well, 2019).

6.6. Response and Preparedness

Community members should be prepared with disaster kits and have a plan of action to respond and communicate effectively during a disaster. However, in Canada, only 20% to 50 % of the population is prepared for disaster at the household level. There are multi-level barriers that may prevent people from doing so. Some of them include time investment, lack of resources such as money, not understanding why it is their responsibility, and lack of knowledge (e.g., where to get information and how to get started). One of the examples is that the preparedness plans are often buried deep within an official website, which can lead people to get lost or get distracted from the primary motive and end up closing the website without completing the task (Ryan Reynolds in Coast and Ocean Risk Communication CoP, 2022).

Furthermore, people often have difficulty preparing for future disasters due to various behavioral biases. Such as optimistic bias, which means that people are likely to think they are less likely to be harmed than others. Next is the normalcy and status bias, making

people underestimate the risk and believe the best-case scenario, also assuming the future will be like the past; hence they do not feel the need to prepare. Another bias is the relatively low likelihood of disaster, meaning they assume nothing will happen, and the prospect theory states that immediate costs are considered more severe than the potential future costs. Lastly, anchoring on past events can lead people to believe that future disasters will play out similarly, so now that they are experienced, they can manage the situation (Ryan Reynolds in Coast and Ocean Risk Communication CoP, 2022).

7. Primary Research

7.1. Overview

Primary research was conducted with two major stakeholder categories, i.e., the experts and the general population affected by disasters. The general population group comprised individuals in BC who are 19 years or older and have experienced fire, flood, or landslide. Survey and interview questions were prepared after analyzing the secondary research. I also conducted an autoethnographic study by participating in volunteering training for the Emergency Support Service at the City of Vancouver. It was to understand the government and volunteer perspective at a deeper level. This research was approved by the Emily Carr University of Art + Design Research Ethics Board (ECU-REB). See Appendix A.

Research Limitations

Total number of online surveys (18) + interviews (4 experts + 6 General Population) = 28 Participants.

It was not possible to observe the disaster scenario firsthand due to the risk factors, but with the help of documentaries, news, and vlogs, the disaster situation could be observed. Limitations surrounding this research project include a limited sample size of 28 participants, with participation based on disaster experience, research interest, and time availability. A bigger sample would enhance the reliability of the research.

7.2. Survey

SurveyMonkey was used to conduct surveys, and it was open from June 2022 to August 2022. The goal was to know how communities in BC get alerts, feel about the emergency communication system, get help during an emergency, and whether they volunteer.

Survey Findings

The survey aimed to understand how communities in British Columbia receive disaster alerts, their perception of emergency communication systems, how they seek help during emergencies, and whether they volunteer.

The survey analyzed the experiences of participants ages ranging between 19 to 65 from various rural and urban locations in British Columbia who had encountered disasters. The most common type of disaster experienced was floods; no participant has experienced more than one disaster type. The study revealed that the primary sources of help during a disaster were police officers, firefighters, and friends. It is also important to note that all participants who volunteered to help were not a part of any official organization; this shows that humanitarian selflessness is at the core of how communities come together during a disaster.

Social media platforms such as Facebook and people in close networks played a pivotal role in alert information distribution, according to participants who encountered/ survived a disaster. The study found that accessibility to important information about the disaster in a timely manner was underwhelming to community members at large. This highlights a significant gap in emergency communication systems in British Columbia. The study further reveals participants' difficulty communicating with their loved ones, friends, organizations, and the government during the disaster. Online communities were crucial in providing assistance and reliable information during disasters.

The study found that the people of British Columbia expect improvements to the existing emergency communication system to enhance its effectiveness. These include total coverage of emergency phones on major roads, better-prepared plans, guidance and training for disasters, and support for multiple languages.

In conclusion, the survey highlights the importance of effective emergency communication systems during disasters. It also reveals the importance of social media platforms and online communities in providing assistance and reliable information. However, there is a need for improvement in the existing emergency communication system to enhance its effectiveness and inclusion. The recommendations provided by the participants can be further refined and used as a scale guide to improve emergency communication systems in British Columbia.

TYPE OF DISASTER

Fire
8

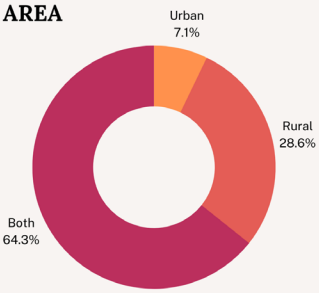
Landslide
3

Floods
3

LOCATION

Vancouver | Sumas Prairie | Barriere | Chlliwack | Abbotsford | Kelowna | Pemberton | Lilooet | Kamloops

AREA



ALERTS RECIEVED

57.14%

FOLLOW-UP RECIEVED

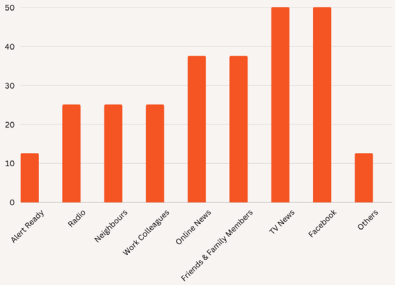
87.50%

ALERTS ON TIME

42.86%

Participants noted timely alerts and follow-ups, however they noted that they were **NOT** informed in a timely manner.

ALERT SOURCES

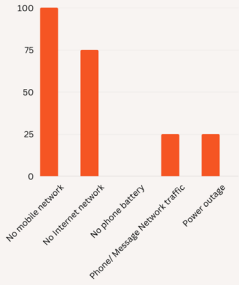


DIFFICULTY IN COMMUNICATION

28.57%

Participants had difficulty communicating with loved ones, friends, organizations, and government authorities during the disaster.

REASONS

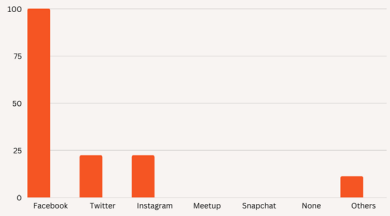


PART OF ONLINE COMMUNITIES

64.29%

Participants were part of Facebook, Twitter, Instagram, Reddit and TikTok.

ONLINE PLATFROMS

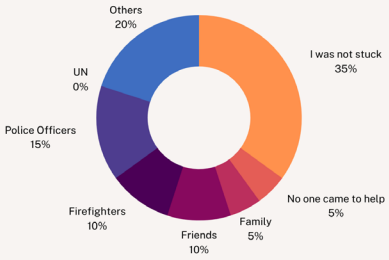


RECEIVED INFROMATION

77.78%

Obtained valuable information and assistance from online communities and groups, which played a crucial role in navigating the challenging situation.

HELP RECIEVED



HELP GIVEN

78.57%

Actively sought out and contacted people, offering assistance and support to those affected by the disaster.

VOLUNTEER ORGANIZATIONS

The Participants acted independently, displaying a sense of duty and dedication by taking action to help those affected by disasters without being part of a volunteer organization.

Figure 9: Survey analysis and points of interest

7.3. Interviews

One-on-one interviews were conducted face-to-face and via audio/video calls from June 2022 to September 2022. The interviews aimed to analyze the general population's experiences and actions taken in disasters to understand human behavior; and the reasons behind using specific modes of communication. Through the expert interviews, I wanted to understand the government, volunteering organizations, academicians, and practitioners' perspectives.

There were a total of six participants in the general population category. One of the major difficulties was finding people who had experienced disasters in BC to participate in the interview. Participants from this category lived in BC, but their disaster experiences were from different countries, such as the USA, India, and Mexico. Hence during the analysis session, only elements which were valid in the context of British Columbia were selected for further insight generation. The BC context references were taken from the secondary research and the expert interviews.

The expert interviews helped bridge those gaps in the research by understanding their experiences, thoughts, and insights. There were a total of four expert interviews conducted.

Affinity Mapping

After obtaining the consent of the participants, I recorded all of the interviews through audio recordings or written notes. I subsequently studied and interpreted each participant's raw data. For analyzing the interpreted data, I used the affinity mapping method. It is an approach to organizing and sorting data into themes based on identified relationships and patterns. I prioritized working on the themes based on the repetition and the relevance to the thesis topic, duration, and resources, as some of the major themes, like power outage and community building, would require a more extensive scope of research. Therefore, these priorities were the deciding factors of focus areas of the design principles. There were seven major themes and more than 30 sub-themes generated from the affinity mapping.

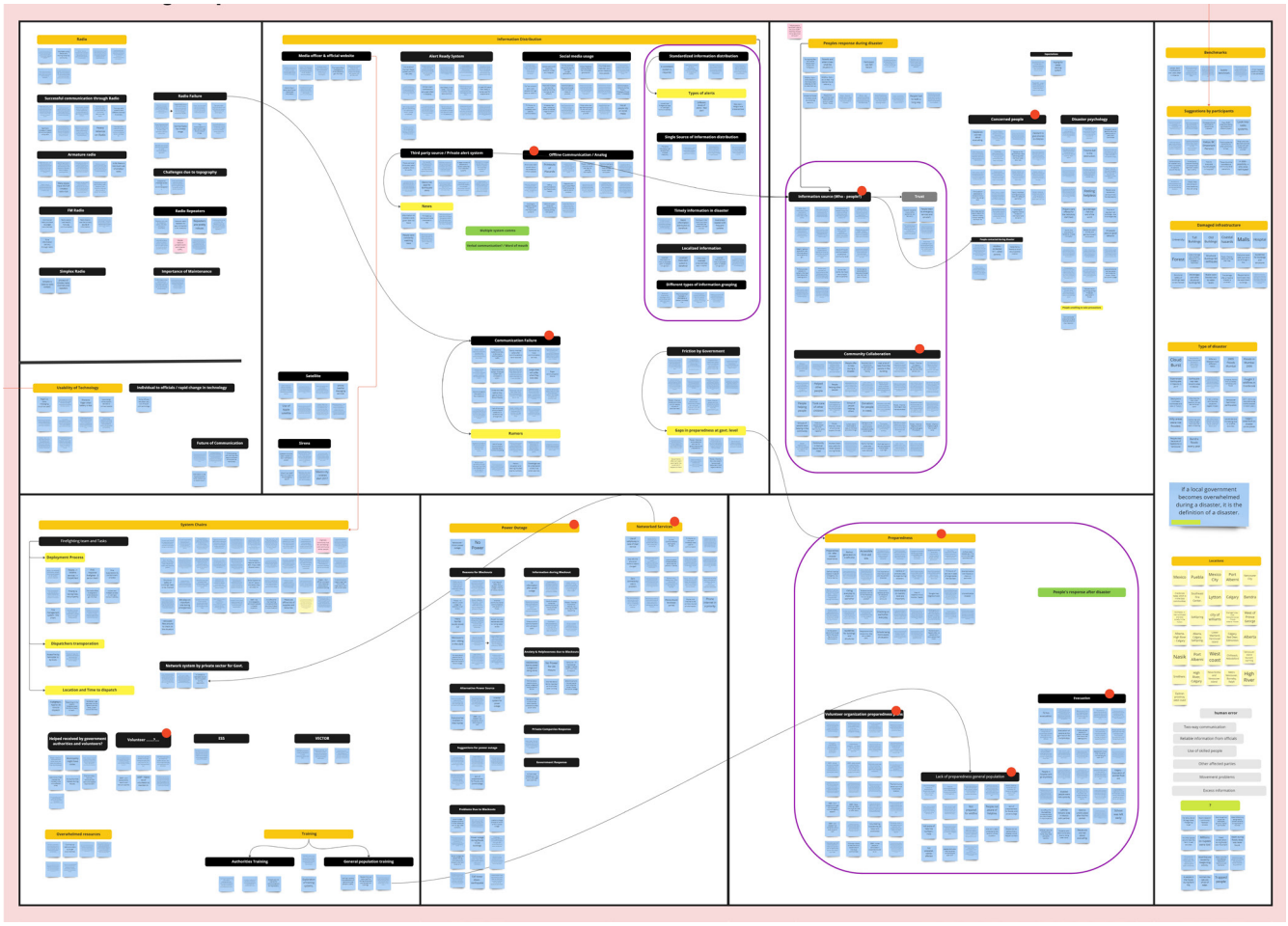


Figure 10: Overview of the Affinity map on Miro

7.4. Design Principles and Insights

After analyzing and synthesizing the existing communication systems and understanding the needs of people during disasters through various research methods like secondary research, autoethnography, situational workshops, surveys, and interviews, the following five design principles emerged.

1. Localized Information

Establishing a reliable and standardized source for Information distribution.

Insight: Providing timely and localized information during disasters is essential for people to make informed decisions and take appropriate action. People get overwhelmed by the amount of information distributed during a disaster; consequently, there are higher chances of ignoring the information if it is not tailored to them. During disasters, people are anxious about their safety, family, and friends, the destruction in the surroundings, their homes and possessions, and their ability to support themselves. Therefore, providing localized information is crucial as it is more likely to be acted upon. In order to ensure that the communities trust emergency information, it is essential to have a consistent system in place that provides accurate and timely information from a single source to prevent a repetition of information that causes confusion. Also, to ensure that everyone receives the message in the same way. This information must be distributed from a trusted and reliable source, such as emergency services and community leaders, to be taken seriously. Identifying multiple ways of distributing information is also important, as different types of people may have different ways of grasping information. This information can include maps, audio, video, infographics, or status updates on the situation.

2. Community Collaboration

Collaboration among diverse community members before, during, and after natural disasters.

Insight: During a disaster, people give and receive help from their surroundings as they are the closest to them. Community collaboration is essential for natural disasters because it allows people to unite and leverage each other's resources and knowledge to better prepare for and respond to disasters. However, it is observed that the help provided by the general population is unorganized, which causes miscommunications, and people might end up missing the opportunity to receive the help. Communities will always help

each other without anyone telling them to do so. To ensure that the help is organized and well-coordinated, it is necessary to create a space for communities to get to know each other and collaborate during, before, and after a disaster; this will enable them to take fast and effective actions in the event of a disaster. If people are already acquainted with each other, fast actions can be taken. It will help them to coordinate relief efforts, identify resources and needs, and develop plans to rebuild and recover more quickly. Additionally, community collaboration can help reduce a disaster's psychological effects, such as fear and anxiety, by providing a sense of safety and security. Working together also helps build communities' resilience to better prepare for, respond to, and recover from any future disasters.

3. Everyday Communications

Use everyday communication mediums like social media to ensure widespread access to disaster information and assistance.

Insight: In today's world, everyday communication is an integral part of our lives as it facilitates the exchange of information and ideas between individuals. We use it to stay in touch with our family, friends, and colleagues and to receive updates about the world around us. As a result, it is no surprise that people have grown accustomed to using the products they use daily and, thus, require minimal effort when it comes to understanding its functionality. This means that even in the event of a disaster, people are less likely to spend time understanding a new product and more likely to rely on the products they are familiar with (Bishop, 2015; Korstrom, 2021).

In such scenarios, it is essential for authorities/ practitioners in the field to use everyday communications like phone calls, text messages, and social media to notify people about the disaster; This ensures that the information is accessible to a wide range of people and that they can stay connected with their loved ones. Furthermore, it is essential in times of disaster as it provides a platform for communities to communicate, share updates, and offer support.

Emergency communication systems should also have multiple communication mediums, both digital and analog, as well as different levels of alerts tailored to the needs of the people in the affected areas. However, this thesis mainly focuses on communities with access to the internet and social media during disaster situations which are highly scalable systems.

4. Government and Community

Government recognition for valuing the role of community members in disaster preparedness and response actions.

Insight: During disasters, communities in the affected and nearby areas are the most important people, as they are the first to step up and take action. A study by the Canadian Red Cross Disaster Management makes a strong argument for the need to change the paradigm of viewing the general public as "survivors" who can actively contribute to disaster recovery rather than as "victims" of disasters. The government recognizes and values the role of community members in disaster preparedness and response. With the government's support, communities can become more organized and self-reliant. The support could include setting up systems that enable communities to work together to identify their specific needs and develop plans to address them. Furthermore, with the help of government preparedness plans, communities can become more familiar with the risks associated with disasters. The government could also encourage the communities to form networks and partnerships with other organizations and agencies like the city of Vancouver and community centers to better prepare for and respond to disasters. Through these government efforts, the communities could be more resilient during disasters. In addition, people are more likely to follow the strategic plans when such support is given from the government rather than any other third party.

5. Easy access to Preparedness plans

Quick and easy access to preparedness plans by the government based on the needs of the community.

Insight: It is challenging for people to make an effort to locate and understand the plans as the information is disseminated. Moreover, different people have different ways of grasping information during disasters; therefore, more diverse styles of preparedness plans should be made.

The primary challenge of communities to search for information and understand where to begin could be tackled by making the information localized; this will ensure that the scattered information is well specific to communities' needs, preparing them for a disaster. Moreover, the Government's expertise and guidance will be invaluable in equipping community leaders with the knowledge and resources they need to effectively share disaster-related information with their local population.

Easy access to information is the most important element to prevent the disaster's effects

even before it starts. Communication preparedness is one area where the Government can implement robust and foolproof systems; this will ensure the community's welfare through localized plans and actions taken in a disaster situation.

8. Ideation & Conceptualization

An extensive literature review and primary research were conducted during the research process, in addition to exploring different emergency communication approaches within studio classes utilizing research-through-design techniques. This approach involves a research process in which the researcher applies exploratory methods to address a particular research question or subject, using design as a means of exploring the issue (Dalsgaard, 2010). The principles of research through design, which include iterative, exploratory, and constructive elements, characterize designerly reflection and practice, gaining a more profound understanding of the subject matter.

The method was initially employed to assess the efficacy or inadequacy of communication strategies in tackling present and future emergencies. However, after identifying the most viable design outcome—a scalable and reliable solution—the focus shifted to conceptualization. The following table presents the analysis process for the selected design direction, using design principles as the criteria for the selection process.

Timeline	Sr. No.	Ideas	Design Principles				
			Localized Information: Establishing a reliable and standardized source for Information distribution.	**Community collaboration:** Collaboration among diverse community members before, during, and after natural disasters.	**Everyday communications:** Use everyday communication mediums like social media to ensure widespread access to disaster information and assistance.	**Government and Community:** Government recognition for valuing the role of community members in disaster preparedness and response actions.	**Easy access to preparedness plans:** Quick and easy access to preparedness plans by the government based on the needs of the community.
Spring 2022	1	**Interactive Maps for Researchers:** Interactive maps for researchers for holistic visual reference of disaster data for critical analysis. A website to understand and find patterns to evaluate emergency warning levels with the help of overlay maps, 3D environments, and augmented reality (AR) and other related thechnologies.	✗	✗	✗	✗	✗
	2	**Pocket guides**: Localised guides will include offline printed maps and other important resources (Safety shelters, contacts etc) that will guide communities to take action and reach toward safety.	✗	✗	✗	✗	✓
	3	**Community Data collection platform:** a volunteer platform to store (online + offline) information like contact, skills, resources, etc., so that community centers/leaders can get in touch during emergencies.	✗	✓	✗	✓	✓
	4	**Emergency Posters:** Sharing information during and after disasters (power outage situation).	✗	✓	✗	✓	✗
	5	**Network drones:** Unmanned aerial vehicles as moving antennas that serve as the access points for internet communication.	✓	✗	✓	✗	✗
	6	**Interactive information board:** Providing clear instructions via visuals to educate people on emergency preparedness and disaster awareness using a QR code that links to safety shelters and volunteer sign-ups. An AR option to visualize potential disasters to educate people on the scale of risk involved. Engaging and interactive information board for people in the vicinity. Encouraging people to scan the QR code and explore the available resources. The potential addition of NFC to help people access and share information to & fro reliable sources during emergencies.	✓	✗	✗	✓	✓
	7	**Buddy system for emergencies:** People who live alone and are vulnerable can connect with negibhours who will give and recieve help during disasters. **(App)**	✗	✓	✗	✗	✗
	8	**Network Jumpers (Mesh network):** A system of network hardware to extend and scale the communication area limit to help people to communicate during emergencies.	✗	✗	✗	✗	✗
	9	**Guidance Light Beacons:** Guidance for people to reach safety shelters via temporary light beams set up during disasters.	✗	✗	✗	✗	✗
Summer 2022	10	**Domestic House alerts and warnings:** Houses with built-in smoke detectors & fire alarm systems used for emergency announcements by the government during disasters.	✗	✗	✗	✗	✗
	11	**Disaster Stimulations inside Metaverse.** Through the platform community people are able to reach people all over the world for information. Mass training.	✗	✗	✗	✓	✓
Fall 2022	12	**Universal Information platform:** One reliable platform for all kinds of disaster information and communications. Sharing and receiving information through the use of social media.	✓	✓	✓	✓	✓
	13	**Communication on Wheels:** Improvising and increasing the capacity of portable generators in the existing cell on wheels and creating better connectivity strategies for connecting communities.	✗	✗	✗	✗	✗
	14	**Mobile + Radio + Portable Manual Charger:** Integrating radios into smartphones for additional information sources for people, as it is one of the essential factors of preparedness.	✓	✗	✗	✗	✗

Figure 11: Idea selection matrix (1 to 14)

Timeline	Sr. No.	Ideas	Design Principles				
			Localized Information: Establishing a reliable and standardized source for Information distribution.	**Community collaboration:** Collaboration among diverse community members before, during, and after natural disasters.	**Everyday communications:** Use everyday communication mediums like social media to ensure widespread access to disaster information and assistance.	**Government and Community:** Government recognition for valuing the role of community members in disaster preparedness and response actions.	**Easy access to preparedness plans:** Quick and easy access to preparedness plans by the government based on the needs of the community.
	15	**Public Announcement + Gov. Radio System:** Street lights are everywhere; this feature could be installed at intersections of streets after measuring the sound travelled between buildings to reach the general population during an emergency. The radios systems are in case of a network outage, after which a government official will then utilize it to pass on the important information.	✓	✗	✗	✗	✗
	16	**Wearable Satellite Device:** The wearable satellite device is a small, portable device that can be worn on the body. It is equipped with a satellite receiver and a GPS receiver. The device can be used to track the location of the user, as well as to receive and send data. The watch can be used for their daily use and it allows the user to find the satellite signals and can send text mgs and voice through them. (Audio to text feature)	✗	✓	✓	✓	✗
	17	**Power outage Communications Guidelines Kit (digital and analog):** Community level awareness of situation, Dispersion & response to actionable information **(Maps, Critical contacts, Communications survival strategies, Building communities guidelines, etc)**	✗	✓	✗	✓	✓
	18	**Community Building Kit:** Connecting people with neighbors before disasters to support each other during emergencies (Self-sustaining system).	✗	✓	✗	✓	✓
	19	**Hyper Local Communication Preparedness plan:** Promotion of community members' participation in emergencies through providing forms (eg, sharing their skill sets) and kits which in-turn builds community resilience.	✗	✓	✗	✓	✓
	20	**Portable Power Generators:** Modified solar panels and generators that are portable, affordable, and easy to use for community members during times of power outage during disasters.	✗	✗	✗	✗	✗
	21	**Gamifying preparedness plans (Mixed reality platform to reach different user groups):** Gamifying preparedness plans can increase people's interest in emergency preparedness by introducing challenges and rewards. This also makes the preparation process more motivating, enjoyable, and engaging.	✗	✓	✗	✓	✓

Figure 12: Idea selection matrix (16 to 21)

Conclusion

Analysis of the ideas shows that the universal information platform idea met all design principles criteria. Other ideas point towards system-level communication strategies, preparedness plans, interactive maps, and community-building plans. Even though community-building for pre-disaster situations is an important direction, the explorations revealed it would require more time and re-alignment of research. Therefore, it was decided to pursue this as a future step.

Based on the analysis, it was finalized to focus on the 'universal information platform' idea as it utilizes social media to bridge two-way communication gaps within communities. It also allows the expansion of the platform for government and community collaboration. In addition, this idea could be further refined to incorporate the compelling features of other ideas. Hence the target audience of this design outcome narrowed down to British Columbia communities with access to the internet to reach a wider user base–before, during, and after natural disasters.

The Design Directions

1. Localized disaster information gathered from different sources in a single platform based on the user's location.
2. Two-way communication between government and communities for sharing and receiving important information.
3. Community collaboration for giving and receiving help.
4. Using Social Media for communications before, during, and after disasters.
5. Interactive and real-time map for giving and receiving help (easy-to-grasp visual information)
6. A government-initiated platform for public Confidence
7. Online and offline guidelines for community preparedness

8.1. User Persona

John

FUNCTION: Farmer
LOCATION: Fraser Valley, BC
GENERATION: Millennial, Digital Native
LANGUAGE: English

BACKGROUND
- Life long Farmer
- Family owned farm
- Hard working & Dedicated
- Forward Thinking in Technology

NEEDS/GOALS
- Make his farm more efficient by using Technology
- Expand his Distribution network
- Automate Processes to reduce time
- Implement Sustainable practices
- Finding Reliable source of information on Disasters

CHALLENGES/FRUSTRATIONS
- Adoption of New Technology - Costs and Access
- Resources to purchase the Latest technology
- Access to High speed Internet
- Sorting Through Conflicting Information on Disasters

BIO
John is a 35 year old farmer living in the Frazer Valley, an area recently devastated by floods. He is trying to make sense of the chaos brought by the disaster, and is relying on various media sources to gather information and make decisions. He is becoming increasingly frustrated and confused as he tries to make sense of the conflicting reports and information available to him. He is desperate to find reliable sources of information to help him and his family make it through this difficult time.

«I'm looking for a better source of information on Disasters.»

Roya

FUNCTION: International Student
LOCATION: Vancouver DT, BC
GENERATION: Z, Digital Native
LANGUAGE: English, Farsi

BACKGROUND
- Graduate studies in Fashion
- Lives alone
- Social Media Influencer
- Tech Savvy and Explorer

NEEDS/GOALS
- Finish her graduate studies and secure a job
- Improve her English language proficiency
- Increase her fan base by creating more videos
- Connect with other influencers around the world
- Stay up-to-date with news and emergency information

CHALLENGES/FRUSTRATIONS
- Inability to effectively converse in English
- Language barrier connecting with other influencers
- Time constraints due to her studies
- Unreliable and fake news in social media

BIO
Roya is a 24-year-old international student from Iran. She lives alone in downtown Vancouver and is tech savvy. She's uses apps to manage her daily life and is an influencer, giving fashion advice to her followers. Roya has difficulty with the English language and wants to improve her proficiency. She relies on social media for news, updates, and emergency information. Her knowledge of tech and fashion have made her a well-rounded individual, but she still struggles with language.

«I am looking for reliable access to local news and other instant information via social media.»

Figure 13: User Persona 1 and 2

Alice

FUNCTION: Local Business Owner
LOCATION: Abbotsford, BC
GENERATION: X, Digital Native
LANGUAGE: English, French

BACKGROUND
- Book Store Owner
- Mother of two
- Easy going and sociable
- Daily Tech user

NEEDS/GOALS
- Get a Bigger space for the Business
- Implement Management Software for the Book Store
- Implement e-commerce website for the Store
- Community for collaboration and support
- Being prepared and insured before the emergency

CHALLENGES/FRUSTRATIONS
- Limited Budget for Business expansion
- Learning curve involved in Opensource Mgmt software
- Finding right people to give and receive help
- Finding a right platform for community collaboration

BIO
Alice is a 45 year-old local business owner in Abbotsford. She is a survivor of the 2021 floods and is determined to build a stronger community before disaster strikes. She is passionate about connecting local businesses and people so that everyone can work together to help each other in an emergency. Alice is proactive and wants to ensure her community is well-prepared for future disasters.

«I'm having difficulty in finding right people and community to give and receive help.»

Jasleen

FUNCTION: Homemaker
LOCATION: Surrey, BC
GENERATION: Baby Boomer
LANGUAGE: English, Punjabi

BACKGROUND
- Graduate in Pure sciences
- Former teacher
- Mother of two

NEEDS/GOALS
- Find more people from her community
- Aspire to start her own cloud kitchen services
- Learn to use social media for promotion
- Improve her digital skills
- Build a support network for her venture

CHALLENGES/FRUSTRATIONS
- Slow to adapt to new technology and tools
- Platform for engaging with her community
- Limited resources for her cloud kitchen
- Has difficulty browsing through multiple apps

BIO
Jasleen is a homemaker and Baby Boomer in Surrey, BC, with a background in Pure Sciences. As a former teacher, she values education and connecting with the community. Despite being a slow learner of technology, she is determined to use it to start a cloud kitchen service. She often seeks localized information during emergencies, but she finds navigating different apps and websites challenging, so she turns to her children and neighbors for advice. Jasleen is an independent, resilient woman determined to make her dreams a reality.

«Searching for local news/events and gradually embracing social media.»

Figure 14: User Persona 3 and 4

8.2. Precedent study

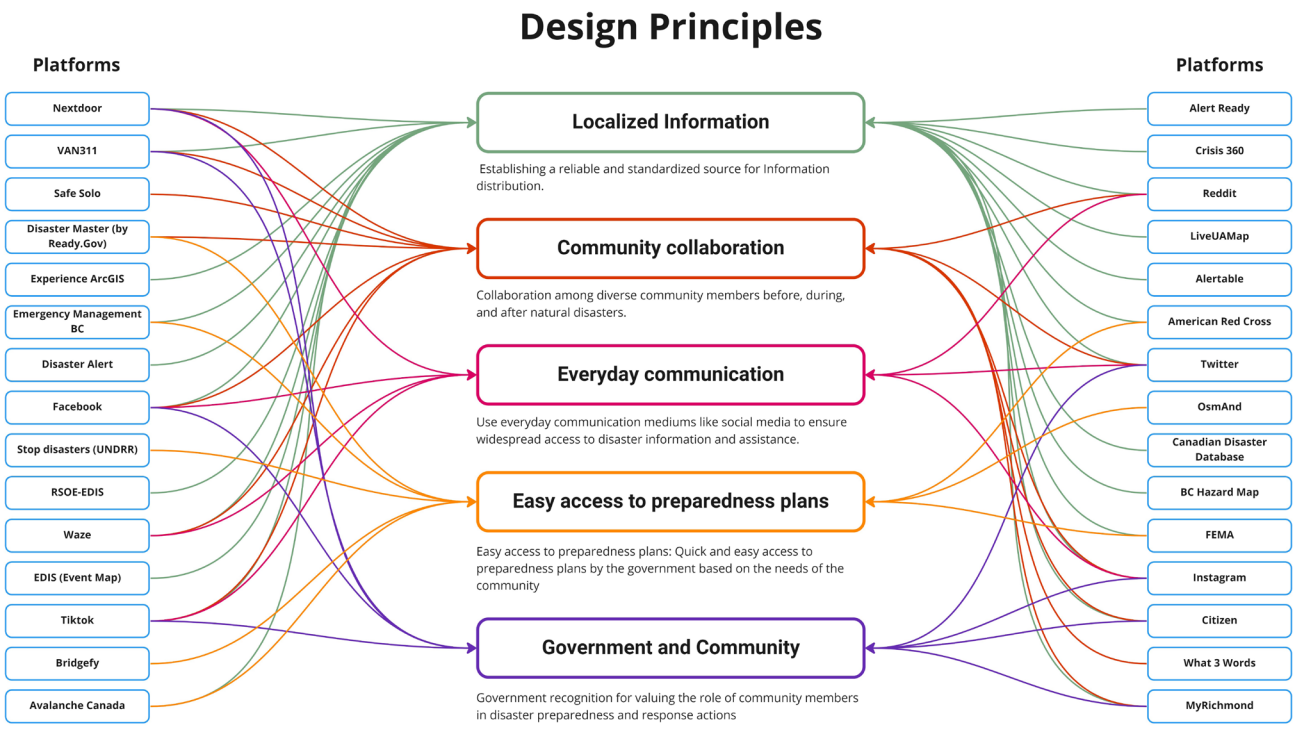


Figure 15: Design principles and explored platforms

The precedent study aimed to investigate various disaster alert platforms and services, emergency interactive map platforms, emergency preparedness platforms, community-building platforms, social media applications, and offline applications. This examination focused on understanding their functionality, user experience, and user interface. The analysis incorporated the majority of the applications referenced in *Figure 15*, while for those that were inaccessible, the websites and their features were investigated. The evaluation was conducted through the lens of user personas and design principles, as established in previous chapters. Examining existing platforms to identify their strengths and weaknesses and discover potential opportunity areas was crucial.

It was observed that all disaster platforms offer localized information and real-time updates on a macro level. For instance, the Disaster Alert app by the Pacific Disaster Center (Disaster Alert (PDC Global), 2022) provides information about the emergency itself. However, it lacks micro-level information, such as safety shelters, road closures, and public transportation disruptions, which are essential attributes during emergencies. Conversely, apps like Alertable (Alertable - Emergency Alerts, n.d.) offer such micro-level localized information, which users find highly valuable. Nevertheless, most disaster applications

employ one-way communication, limiting users from requesting or sharing additional information. Consequently, individuals resort to everyday means of communication, such as Facebook (Facebook, n.d.) and Twitter (Twitter, n.d.), where two-way communication with community members and government officials is possible to obtain the necessary information.

Other applications promoting community collaboration through two-way communication include Nextdoor (Nextdoor, 2023), Waze (Waze Navigation & Live Traffic on the App Store, n.d.), and Citizen (Citizen, n.d.). For example, Nextdoor is a community platform connecting individuals with neighbors and local businesses. During emergencies, users can provide updates, request assistance, and support those around them. Additionally, Waze is a popular GPS navigation application and social network offering real-time traffic data and road notifications. This platform enables users to share up-to-date traffic and road information, such as hazards and closures, with other users in the vicinity. Additionally, Waze provides alternative routing suggestions and navigation functions. Moreover, the Citizen app has elevated the concept of community-oriented emergency applications by enabling user-generated real-time safety alerts and facilitating live streaming of incidents and comments on posts for mutual support. The app also sends alerts when a user contacts 911 through their app or reports an incident. These features empower citizens to receive alerts before government officials issue them, allowing community members to rely on each other in need.

Applications like the American Red Cross Emergency app (American Red Cross Apps on the App Store, n.d.) and FEMA app (FEMA, 2023) offer easily comprehensible and visually appealing emergency preparedness guidelines. They present bite-sized, step-by-step information that users can quickly grasp, along with alerts, important contacts and resources, and safety shelter information. An intriguing platform, Disaster Master by ready.gov (Disaster Master Game | Ready.Gov, n.d.), has gamified emergency preparedness, targeting youth to emphasize the significance of preparedness, planning, and survival skills. The ready.gov platform also features a tool for creating a customized family emergency communication plan. Similarly, the Red Cross app includes a check-in button to ascertain the safety status of loved ones, akin to Facebook's "I am safe" feature, which proves invaluable for users, offering them reassurance and peace of mind.

In summary, while most applications referenced in *Figure 15* effectively serve their intended purpose, only some fully incorporate all design principles. Each application lacks at least one design principle, presenting both a challenge and an opportunity to explore innovative approaches for a successful design outcome.

9. App Design

9.1. Introducing Community Connect

Community Connect is a government-based information-sharing platform that facilitates community collaboration and two-way communication, integrating seamlessly with Canada's AlertReady system. The platform can be accessed via its dedicated app or through the official website. It is designed to aid communities in disaster zones of British Columbia. The name CommunityConnect suggests that this platform is meant to connect and unite different community members, such as, people inside the disaster zone, people outside the disaster zone, public volunteers and government officials. This app is lead by both community members and government authorities. It is to foster collaboration, promote open dialogue, and create a more equitable, sustainable, and resilient community. This hybrid process aims to bridge the gap between citizens and government, ensuring that the diverse needs and perspectives are considered, in decision-making processes and leading to more effective and inclusive outcomes. Community Connect offers a variety of essential features; refer to Appendix B for four user scenarios with narratives illustrating the platform's capabilities.

Following is the information architecture of the app.

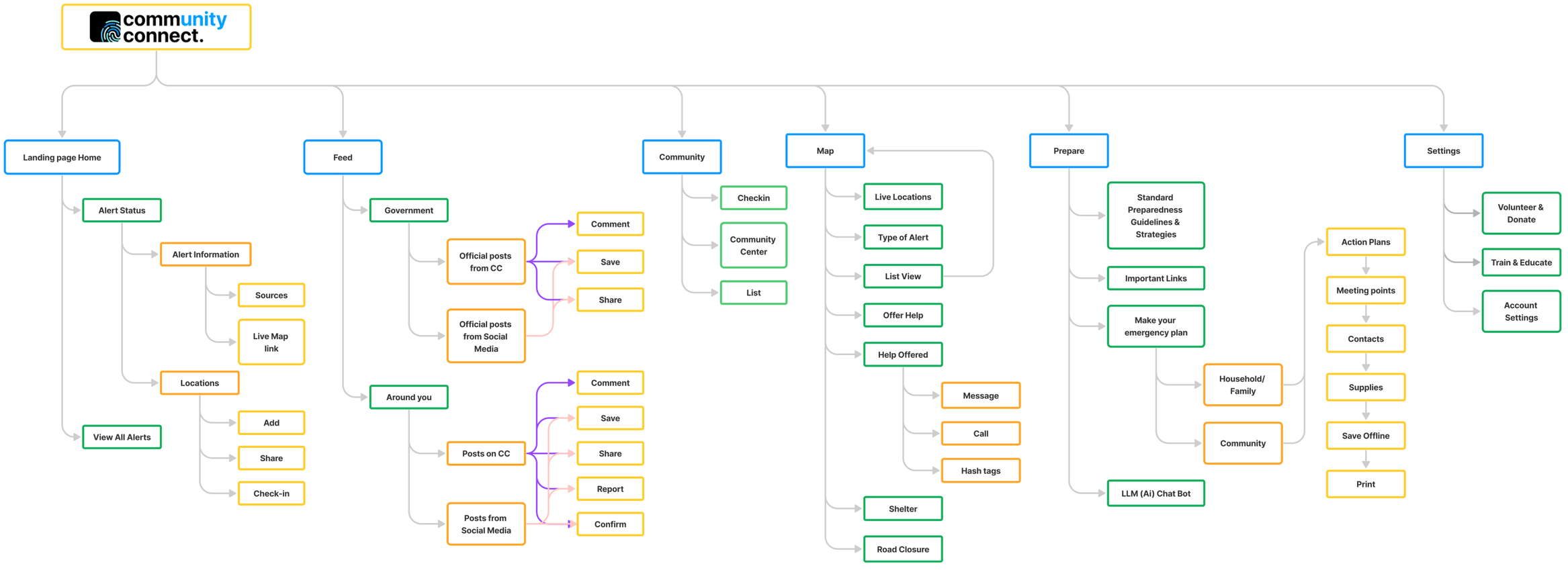


Figure 16: Community Connect - Information Architecture

9.2. Product Strategy

Product strategy is an essential component of success for a product. It is a comprehensive plan for developing and managing products and services. It is a long-term plan to create, market, and deliver the products and services to meet the target audience's needs and achieve its overall objectives. Following are some of the strategies for the Community Connect platform.

A wide range of factors influences people's decision to download and use a government-run app. According to Carter (2005), perceived ease of use, compatibility, and trustworthiness play a significant role in predicting an individual's intentions when it comes to using an online government service. Additionally, users are more likely to use the platform if the service aligns with their expectations and goals. Community Connect app facilitates two-way communication before, during, and after disasters, which is the platform's primary goal. Wang (2020) further pointed out that the participatory use of government apps directly affects trust in the government. In addition, seeing how people interact with government websites and their social media channels has been found to positively affect trust in the government (Khan, 2019).

Having a platform that gives the community more visibility into the government's activities and promotes transparency makes people highly likely to download the Community Connect app. Furthermore, by distributing the app's link through AlertReady, broadcasting the app's use through the BC government's social media and official online pages, and sending letters, a large portion of the population would have been made aware of this app. In addition, multiple other factors motivate communities to use a government-run app, like accountability, privacy, security, and the non-profit nature of the app.

The Community Connect app is designed to be simple to use, compatible, and dependable. It includes government and public participation, making the community feel important and part of the disaster preparedness, response, relief, and recovery process. Furthermore, numerous reliable and timely sources of information would be available to people, as the Community Connect platform's features would reduce the chances of missing important information.

Resources that inspired the app's user experience and user interface are as follows:

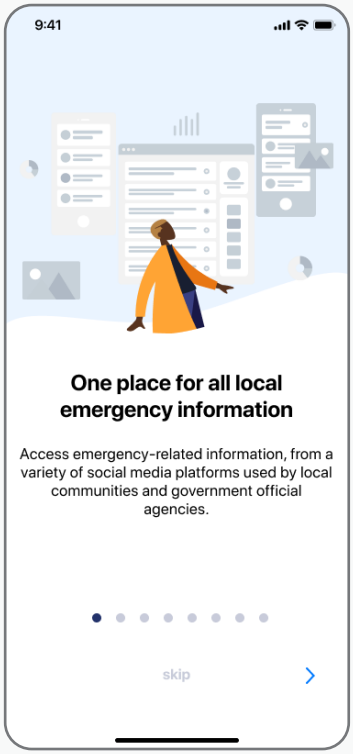
- Marion Lara Tan et al.'s (2020) *"Modified Usability Framework for Disaster Apps: A Qualitative Thematic Analysis of User Reviews,"* which investigates the conceptual framework for disaster app usability.

- Jason Christopher Chan's (2020) "*The Role of Social Media in Crisis Preparedness, Response and Recovery,"* discusses the role of social and how its tools can be utilized in crisis management.
- Government of Canada's (2022) *"Public Safety Canada's Social Media Protocol,"* which outlines government social media use and protocols.
- Mehta, A. M. et al.'s (2016) *"Trust, but Verify: Social Media Models for Disaster Management"* highlights the importance of verifying social media posts during disasters.

Community Connect app's user interface is designed to look similar to popular social media like Facebook and Twitter to achieve the familiarity effect, making it more accessible and comfortable. Users would receive real-time government and user-generated content in a byte-size information format which would be easy and quick to grasp. The app also brings information from different social media platforms using API and hashtags to bring all disaster-related information into one platform. This would also be advantageous for the government as social media is expandable, and integration in currently working and scaleable systems would help them to expand their platform. Another advantage is that the government would be able to understand various patterns more effectively and plan the action points accordingly.

The government will be able to use existing infrastructure to run this platform, and the disaster data and information will be directly retrieved from the connected government database. The app's implementation is for before, during, and after disasters, but it would also be engaging and participatory in peacetime through connecting community members using community centers recognized by the government.

9.3. High-fidelity Screens



Onboarding screens and top features

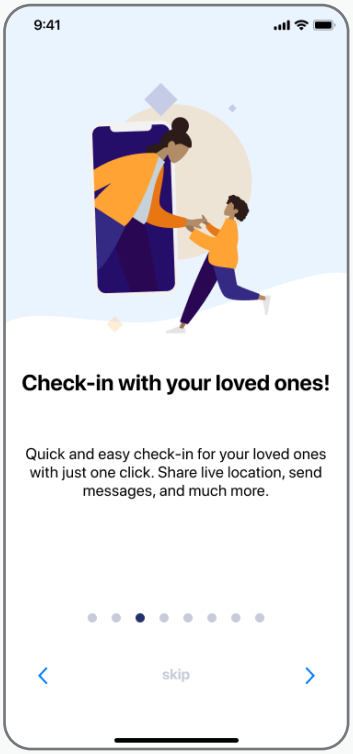
One place for all local emergency information

Communities and government agencies can access emergency-related information from various social media used by the local population in a single platform. This will also help authorities to find patterns and analyze the situation more effectively to prioritize actions and provide support wherever necessary.

Connect with local community members

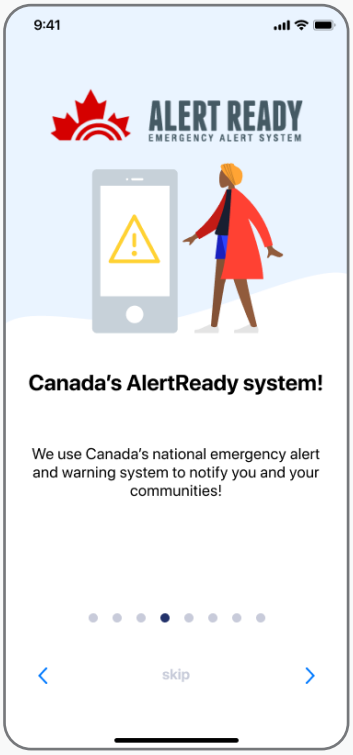
Individuals can connect to local communities before, during, and after disasters, providing them with a sense of security and establishing a support system to foster strong relationships, allowing them to rely on each other in times of need. Additionally, knowing the community members before the disaster will help individuals to be better prepared to effectively respond to and manage the situation as they are already familiar with the people who may be impacted and the resources available in their area. This will also allow them to create personalized and localized disaster preparedness approaches.

Figure 17: Onboarding screens 1 and 2



Check-in with your loved ones

Individuals can check in with loved ones with just one click; this will allow users to save the phone battery and internet data. Users can share live locations and send messages if required.



Canada's AlertReady system

The AlertReady notifications will include a link to the Community Connect app in its disaster alerts, directing users to comprehensive information and guidelines about the situation. This approach will also ensure the app's credibility and help facilitate its widespread adoption.

Figure 18: Onboarding screens 3 and 4

Real-time Map to track disaster information

The map provides real-time updates on disaster zones and information about their immediate surroundings visually, making it easy to navigate. In addition, individuals can search for safety shelters, blocked roads, hospitals, digital volunteers, and other essential information.

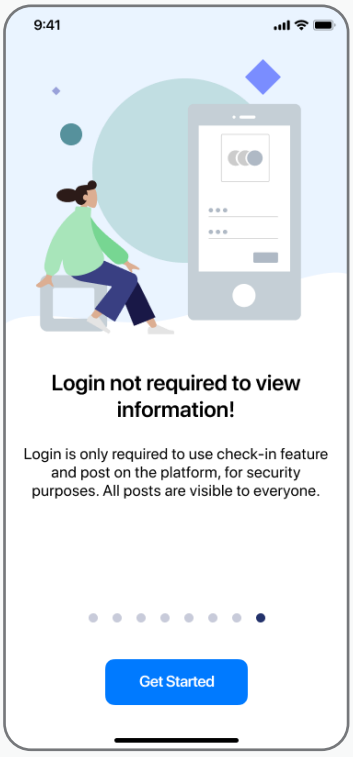
Community Volunteering

Community members in a disaster zone are the first to respond and help each other during a disaster. This feature allows individuals a place to receive or offer help in times of need.

Figure 19: Onboarding screens 5 and 6

Easy access to preparedness plans

The platform allows users, families, and communities to create personalized local emergency plans in addition to the standard guidelines. This information contains action plans, meeting points, contacts, supplies, and more, which can be saved offline and printed. Furthermore, the platform integrates with Large Language Models (LLM) AI, which supports users with natural language search and find features along with suggestive actions for the community for emergency preparedness.



Login is not required to view information

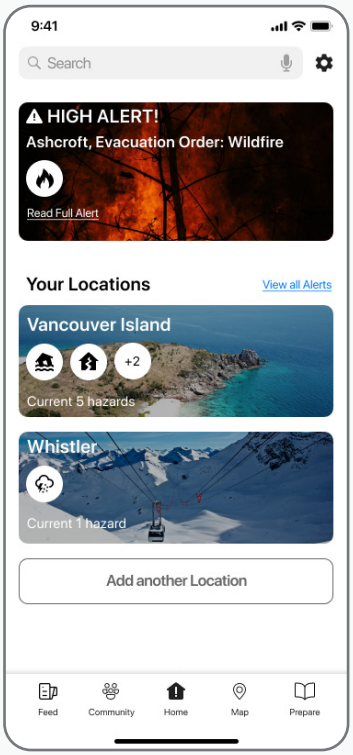
Alerts, map and all posts are visible to everyone. Login is only required to use the check-in feature and to post on the platform. This is for user's security purposes.

Figure 20: Onboarding screens 7 and 8

Home

Alerts notification and locations

The home page is the landing page where all the alerts will be visible. Users can monitor notifications pertaining to their own location and those of their family and friends. This enables users to remain informed about potential dangers and adopt to take necessary precautions.



Home page showing high alert in current location.

Alerts information and description

After tapping on the high alert, information page opens, where relevant details about current disaster is displayed. This is a dynamic page that keeps updating based on the real time data.

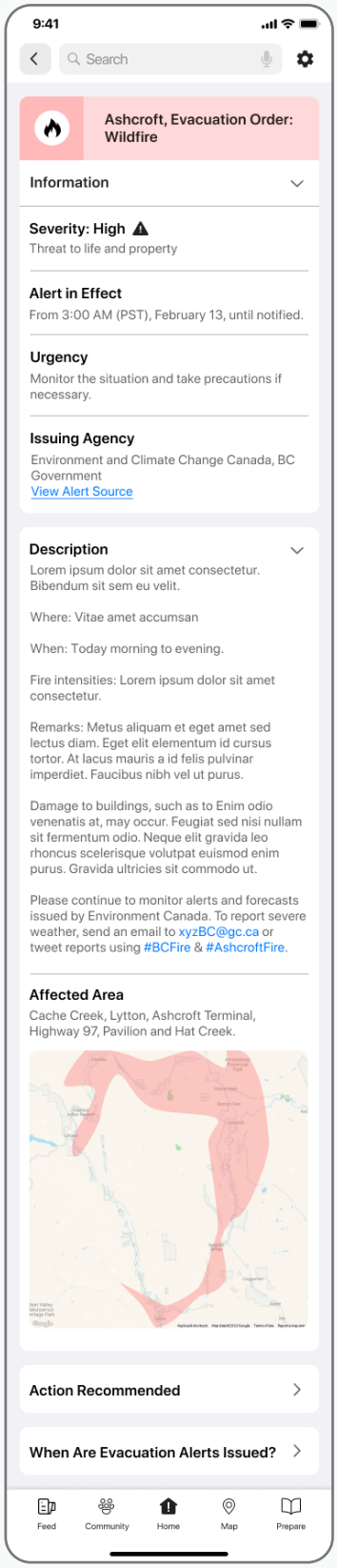


Figure 21: Home page

Community

Check-in, groups, community center, chats and more

Users can engage with others in their vicinity through group and community center chats before, during, and after emergencies. This fosters organization and mutual accountability, helping to maintain a sense of calm in knowing that they have a support network nearby during disasters.

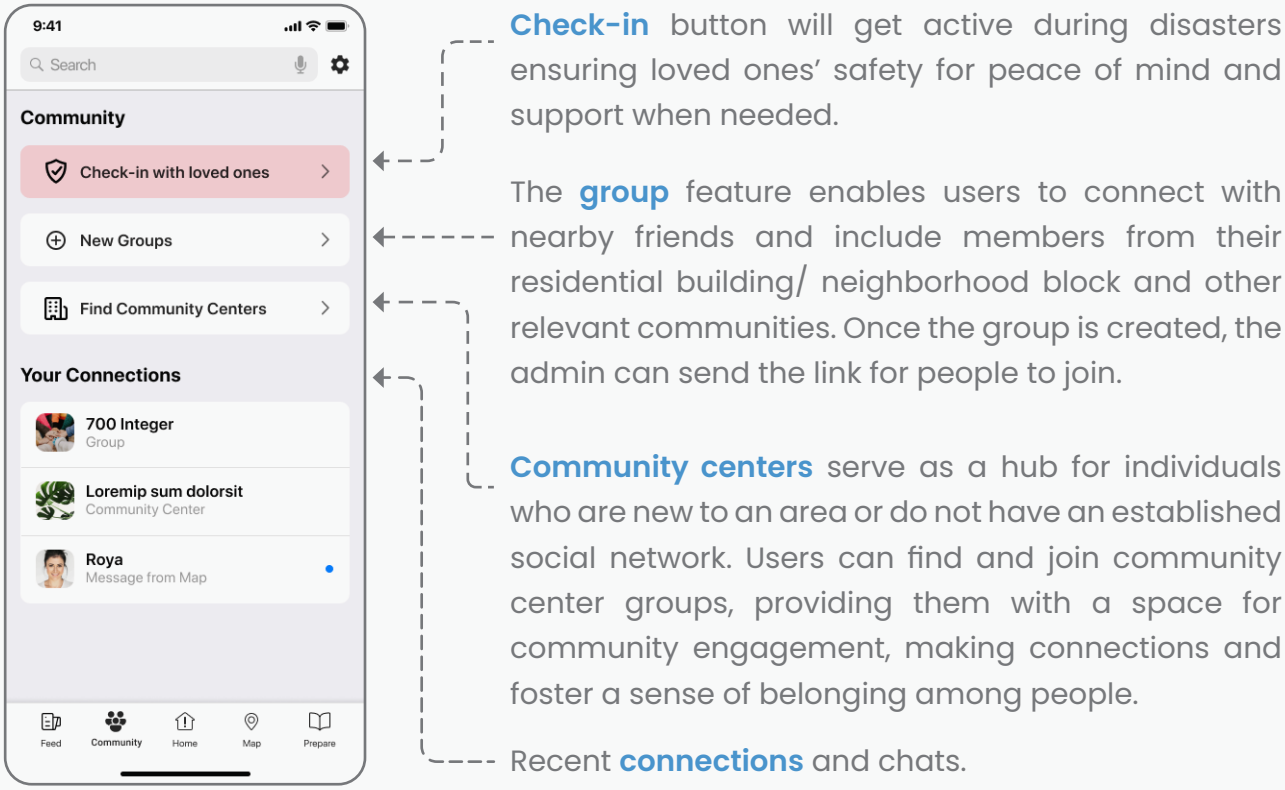


Figure 22: Community page

Feed

Users can access complete, accurate disaster information, guidance and relevant updates from the dedicated **Government** official page. The **Around you** page, consists of all the localized information related to the current disaster. In both the pages, information generated from the community app and information shared from various social media will be compiled together. The API (Application programming interface) will aggregate publicly available information from various social media platforms using #hashtags and geo-locations providing users with a centralized and comprehensive information source.

Saving a post will ensure that it is stored offline, making it available in the event of a network outage. This is particularly useful for important information, such as safe routes to take during evacuations.

On the Community Connect app, users can only **comment** on posts created within the app. To comment on posts from external sources such as social media, users must tap on the post, which will redirect them to that social media platform for commenting and reaching out.

Figure 23: Feed, Government page

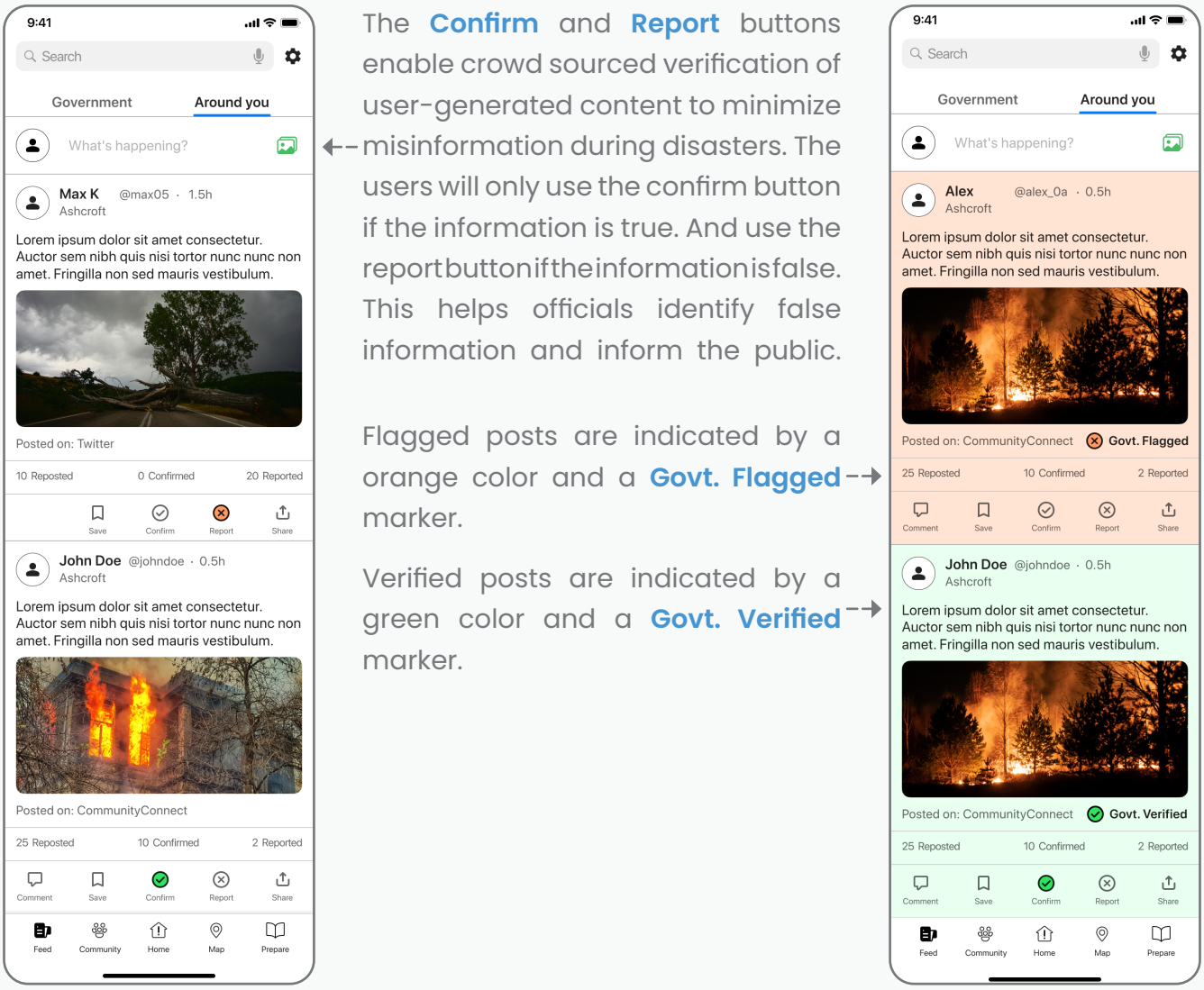
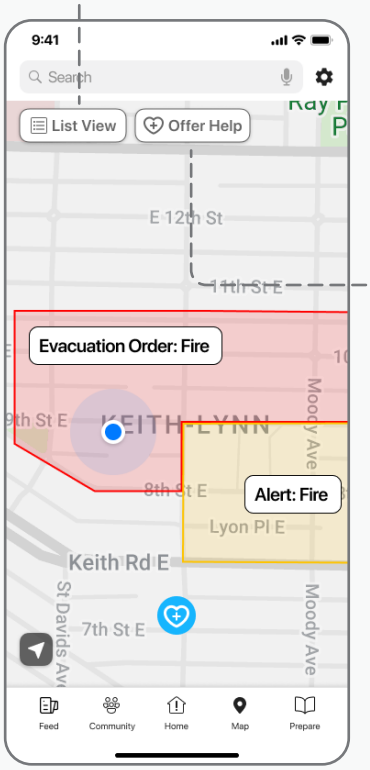


Figure 24: Feed, Around you page

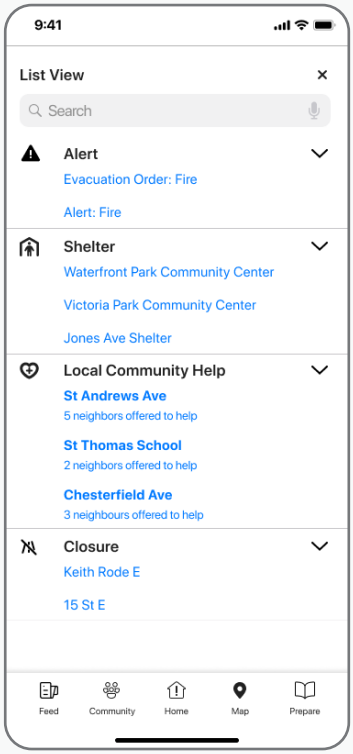
Map

Disaster location, offer help and list view

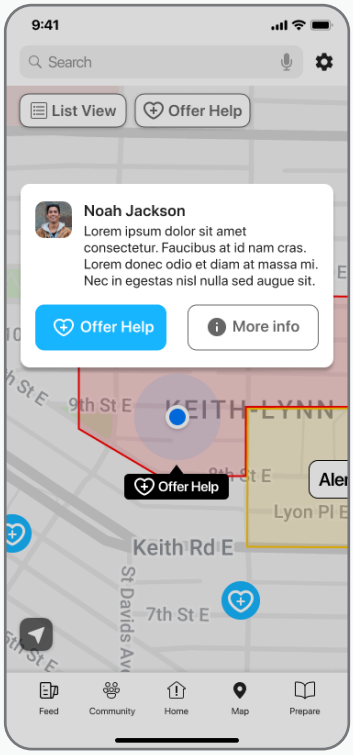
The map page allows users to visually see their current location, disaster alert / order zones, safety shelters, road closures and more.



The **list view** displays all clickable elements on the map, simplifying the search for specific needs.

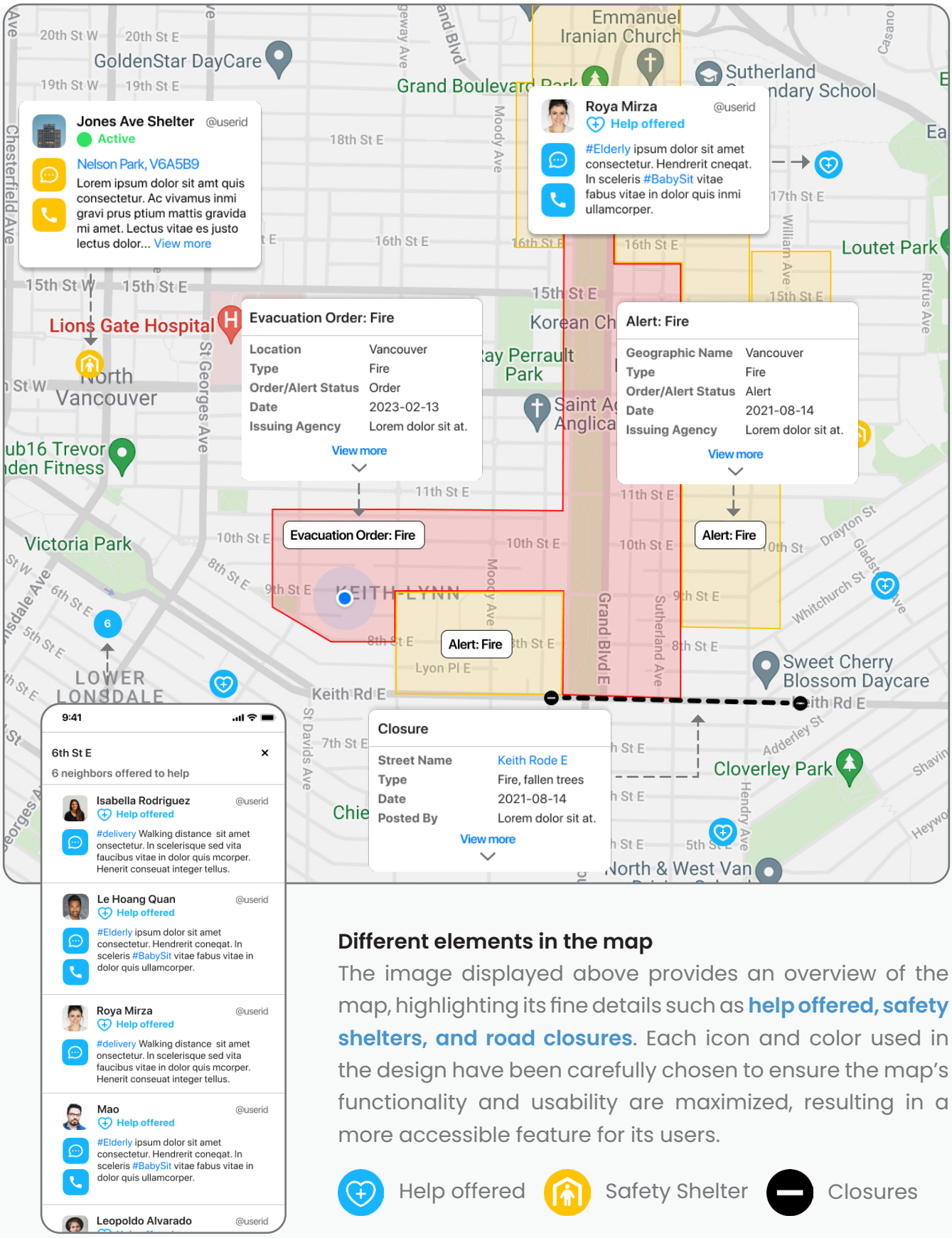


Users can **offer help** local to community members during the times of need.



The live map enables users to visualize the disaster-affected regions highlighted in **two different colors** - yellow and red. The color red signifies areas that requires immediate attention, as they are currently under high alert. On the other hand, the color yellow indicates caution. The regions covered in yellow and red provide a quick overview of the degree of urgency and severity of the disaster in different areas, making it easier for users to assess the situation and take appropriate actions.

Figure 25: Map page



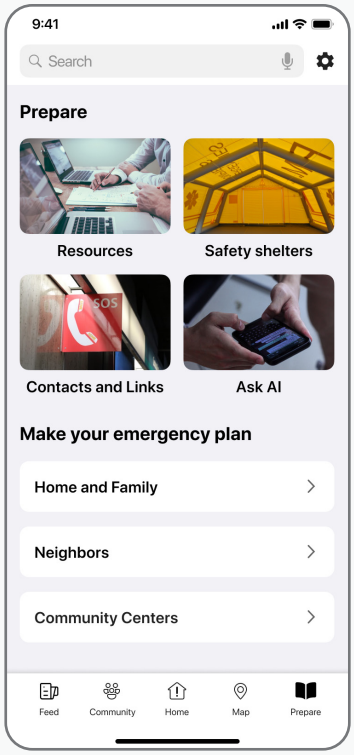
Different elements in the map

The image displayed above provides an overview of the map, highlighting its fine details such as **help offered, safety shelters, and road closures**. Each icon and color used in the design have been carefully chosen to ensure the map's functionality and usability are maximized, resulting in a more accessible feature for its users.

Help offered Safety Shelter Closures

Figure 26: Different elements in the map page

Prepare



The Prepare page provides various localized guidelines and **resources**, information on local **safety shelters**, and important **contacts and links**. Users can prepare a customized emergency plan for their families, neighbors, and community centers.

There is also an **Ask AI** feature, that uses Large Language Models that help users find the right preparedness plans quickly.

Figure 27: Prepare page

9.4. User Interface Style Guide

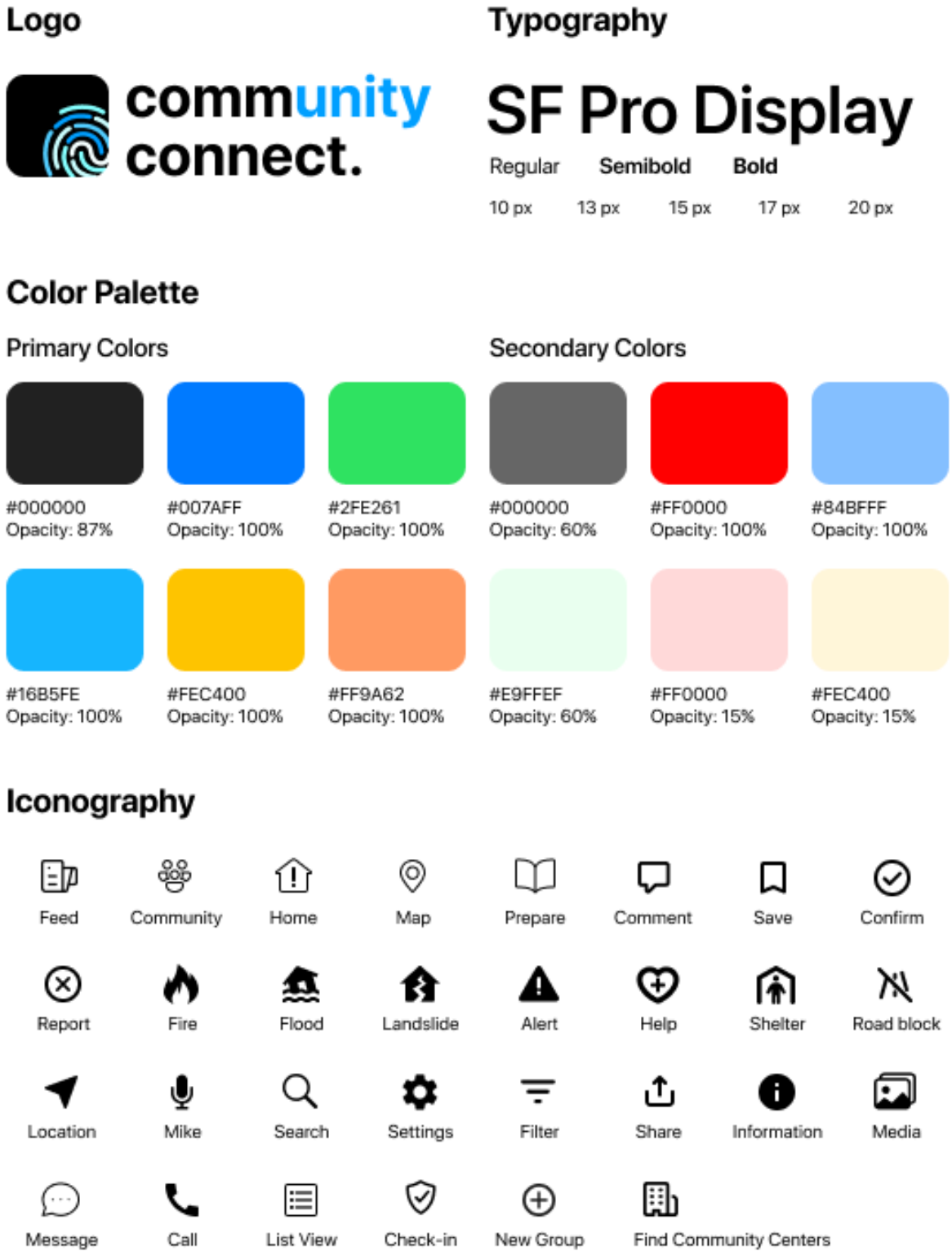


Figure 28: User Interface Style Guide

9.5. App Feedback

This report briefly outlines the Community Connect app's feedback process. Informal expert feedback sessions were conducted in person and via Zoom with fellow designers and faculties from Emily Carr University of Art and Design. In addition, feedback took place throughout the app's design process to ensure it met the following goals.

Feedback goals

- To test the product concept.
- Identify user experience and user interface friction points.
- Identify areas of confusion or difficulty for users.
- Gather feedback to improve the usability and functionality of the app.
- Assess user needs and expectations of the product.

Process

I initially briefed participants on the research insights and app features. Then I facilitated a walk-through of the app screens, encouraging them to ask questions and discuss points of interest and potential shortcomings.

Findings

The participants expressed excitement and appreciation for the concept and functionality of the app, particularly the integration of multiple social media sources and the map feature. However, they stated that particular navigation and button names could confuse users, such as 'media' and 'alerts' in the bottom navigation bar, as well as 'reports' and 'facts' on the 'around you' page. They suggested that the names should be more specific and relatable. The changes were later made in high-fidelity Screens

The discussion surrounding the implementation of the community volunteering and information-sharing feature generated a significant level of engagement among the participants. During this conversation, concerns were raised regarding the verification process of information shared by people. Consequently, further research was conducted, incorporating the 'verify and 'report' information buttons. Additionally, participants discussed the strategies for verifying the identity of the community volunteer and ensuring that the person was safe to approach and not an imposter. The debate centered around two options: (1) to use the BC service card or any other official document to verify the users, thus increasing the login time, or (2) to keep the login minimal to no login so that many people can access important disaster information with ease. Ultimately, after much

consideration, I selected the latter option. The discussion with the participants highlighted that its highly unlikely that an individual would cause harm to another individual, especially during an active disaster. It was also determined that it was impossible to ascertain if the person posed a potential risk despite verifying user profiles through official documents. Nevertheless, further research is needed to better understand human psychology and the probability of individuals exploiting disaster situations for personal gains using social media.

The participants then assessed which page should function as the home page/landing page. While some believed the media page should take precedence, as it would provide the most up-to-date news and information regarding the community, others suggested the map page as it offered a visual representation of information. Ultimately, the majority agreed on the alert page as the home page as intended.

During the discussion surrounding the placement of the 'check-in with loved ones' button, one participant proposed that placing it on the home page during a disaster could be distracting as it could divert attention away from the actionable disaster information and guidance provided. This suggestion was deemed particularly insightful and was utilized in further conversations with other participants to gain their perspectives.

App Feedback conclusion

After many feedback sessions, new changes were implemented in the prototype. Overall the participants expressed satisfaction with the user experience and interface of the app. In particular, they praised the addition of more detailed posts within the feed page and utilizing colors for buttons and government post verification tailored to their respective functions. Additionally, they expressed satisfaction with the map features and interaction. The feedback process yielded invaluable information regarding user experience issues and enabled me to forecast how users engage with the app. Based on this data, I made necessary adjustments and improvements to the app to ensure the design elements met the user's needs.

10. Conclusion

This project seeks to identify the shortcomings of current one-way mass emergency alert systems in order to design an improved two-way communication platform to help communities in British Columbia (BC) prepare for and respond to natural disasters such as fire, flood, and landslide. Through collecting and analyzing data from literature reviews, interviews, surveys, autoethnography, exploratory designs, and situational workshops, this project has acquired an understanding of the challenges at the root of communication systems and established design principles for two-way communication systems for communities. The proposed solution, Community Connect, is a government-based universal information-sharing and community collaboration platform that integrates with Canada's AlertReady system and utilizes social media to bridge two-way communication gaps before, during, and after natural disasters within communities. The logo of Community Connect is a visual representation of the platform's goal to connect communities and unite them during times of need. The design solution incorporates the Human-Centred design, Systems design, Richard Buchanan's (1992) four orders of design, and the 'hybrid process interaction' approach of Social Innovation from Chapter 5 Research Methodology, allowing both those directly affected by disasters and the authorities in charge to use the Community Connect platform cohesively. Reflecting on the above approaches, it is essential to note that Richard Buchanan's four orders of design thinking are not simply categories of objects that reflect the results of design but also places of the invention where designers can discover the dimensions of design thinking by reconsidering problems and solutions. Designers in each of these orders create a framework for human experience in contemporary culture and are also interconnected, with no priority given to any single one. This interconnection of symbolic and visual communications, material objects, activities, organized service, and complex systems or environments suggests the lineage of design's past and present, as well as points to where design is headed in the future(Buchanan, 1992).

In the context of the first order of design, the information design approach was used to address how community members can communicate and collaborate during disasters using the Community Connect platform. For the second order of design, the app incorporates social media elements, which are integral to people's everyday lives. In addition, extensive research was conducted to understand human behavior and the use of various communication channels during disasters. In the third order of design, Community Connect offers features like a feed page and information verification that emphasize organized services, decision-making, and strategic planning to close the

communication gaps between community members and authorities. Lastly, in the fourth order of design, Community Connect targets the broader range of complex systemic challenges related to two-way communications between community members inside and outside disaster zones, public volunteers, and government officials before, during, and after disasters.

Scope and Limitations:
A total of 28 participants were recruited for the primary research; however, acquiring more participants from various parts of British Columbia posed a challenge due to the limited timeframe and resources available. Given the widespread nature of the research, it was only possible to explore a few focused directions that arose. Consequently, some of the themes identified during the primary research and ideation, including power outages, community building, and verifying information and volunteers, could not be addressed in depth. Participatory methods were explored at early stages but were limited due to research timelines which could have given the opportunity to understand the varied perspectives of every stakeholder involved. I also wanted to create a communication strategy for the community that would be a part of people's everyday lives.

This project is ever-evolving as disasters are uncertain, and there are constant changes in technology and human behavior. Sticking with the parameters of this project was challenging because so many research insights had the potential for further investigation.

Future path:
The research on the "Design for Disaster" as a framework or methodology revealed that it was not as widespread as expected despite having a large community of practice. Therefore, creating such a framework could provide a valuable guideline for those working on disaster-related topics.

In terms of the design solution of this project, more investigation is needed to build upon some of the Community Connect platform's features, like the community page, preparedness page, and verification of community volunteers. In addition, further research is required to foster strong relationships among community members in non-emergency situations to enable effective collaboration during disasters. Furthermore, developing a robust system for verifying information and users on the platform is required to ensure its credibility and reliability. Also, it is essential to assess the impact of consolidated emergency information on users' mental well-being and implement features that support individuals.

In this thesis, I have shown Community Connect's first prototype that focuses on users with digital proficiency and a high comfort level using mobile applications. I acknowledge that this platform does not encompass all individuals affected by disasters, and future iterations and prototypes should strive to include a more diverse group. Moreover, the design outcome has not accounted for users with disabilities and those who lack access to technology or the internet; this is due to the limited time-frame and resources available for the thesis. Therefore, future research should incorporate participatory design, universal design, and accessible design methodologies to ensure that these users are represented. This research would further improve the app's experience and increase the consistency of its use by a large population.

In addition, due to limited time and resources, the feedback sessions only involved the designers and faculties of Emily Carr. Therefore, testing and validation with end users and expert feedback iteratively are needed to evaluate the usability and technical aspects for assessing the proposed solution's effectiveness at every stage. In addition, if the app is developed, a simulation of a participatory method is required where communities, government officials, and volunteers participate together in a hypothetical disaster situation, where all the stakeholders get to observe and work on various possibilities to improve the Community Connect platform and see how it could make an impact in the current emergency communication system.

Furthermore, even though the research was limited to BC and natural disasters, the nature of the solution shows that additional research would help expand this app's capacity to assist in various emergencies across Canada. Platforms like Community Connect support communities before, during, and after disasters. The app acts as a tool that empowers communities to become more organized and better equipped to handle disasters through collaboration & two-way communications. As we look to the future, it is important to note that a single product or service alone cannot solve all communication and community-level disaster issues; a comprehensive, interconnected system is necessary to address these problems effectively and develop solutions beyond current emergencies. Thus, a collaboration between the community of practice is needed to work on the systemic structure.

Community Connect is a part of this larger system.

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12. List of Figures

13. Appendices

A. TCPS 2: Core 2022 Certificate

Figure A1: TCPS 2: Core 2022 Certificate

B. User Scenarios

User Flow 1

John, a 35-year-old, shares a home with his aging parents, nearing their 80s. Upon receiving an urgent alert about an active fire evacuation order, he becomes deeply concerned and urgently seeks help transporting his parents to the closest safety shelter, as he does not own a vehicle. In a panic, he calls his neighbor for assistance, but unfortunately, the neighbor is unavailable. Left with no choice, John turns to the Community Connect App for support. To his good fortune, he discovers a volunteer named Raul, actively helping others evacuate in his van. After a brief conversation and phone call, John is relieved to learn that help is en route. Raul arrives with his van in no time, and they all set off for the safety shelter. As they arrive at the shelter, John expresses his heartfelt appreciation to Raul for his assistance and commends his dedication to the community.

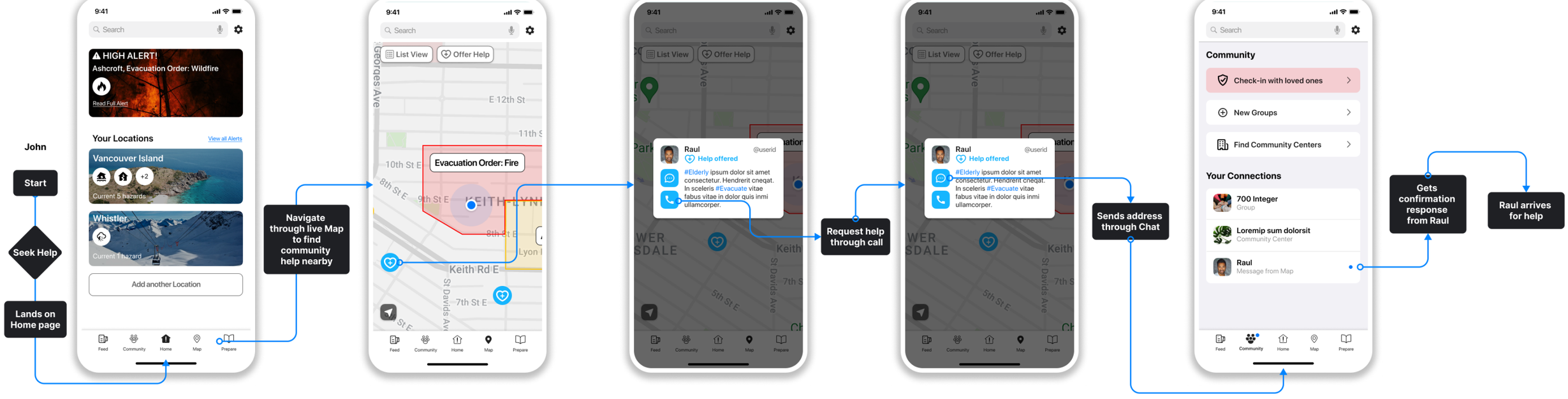

Figure B1: User Flow 1

User Flow 2

Mao, a man in his late 20s, was driving home from a camping trip when he encountered a blocked route due to a landslide. Officials estimated that it would take two days for the road to reopen. Concerned, Mao initially tried to find accommodation at nearby hotels but discovered that they were fully booked because other travelers were facing the same predicament. Growing increasingly worried, Mao turned to the Community Connect app for assistance. Although he could not find any volunteers on the map page, he searched using the hashtags #help, #stay, and #Coquitlam. Soon, he came across a tweet from Shawn, who offered temporary shelter at his home for those affected by the landslide. Mao quickly reached out to Shawn on Twitter and explained his situation. Shawn kindly provided directions to his house, and Mao felt relieved knowing he would not have to spend two days in his car waiting for the road to clear.

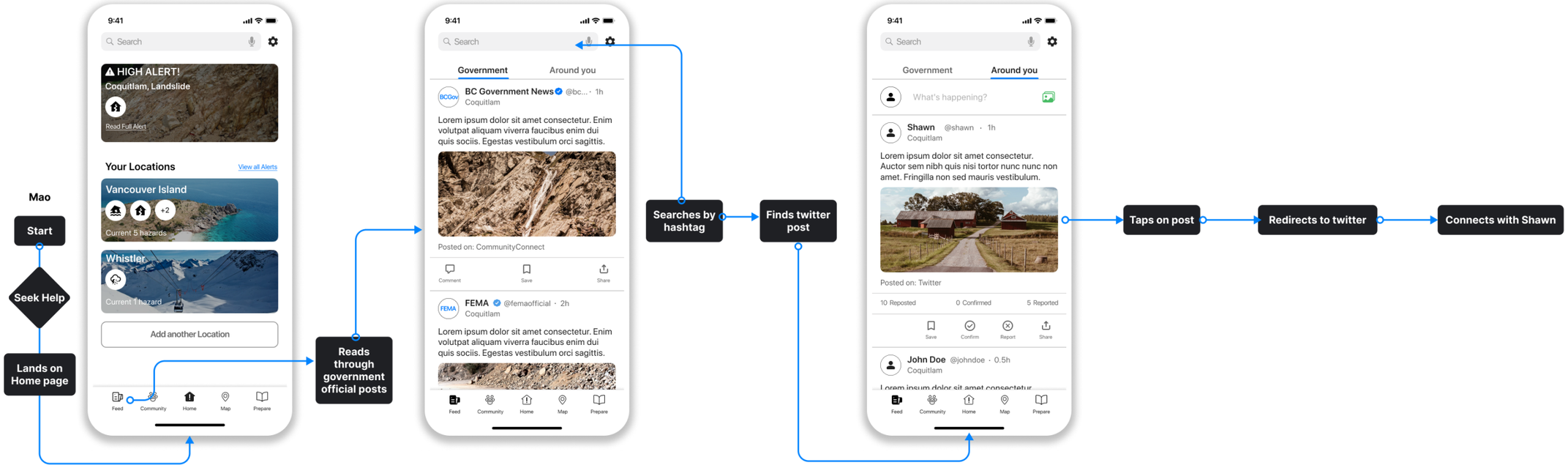

Figure B2: User Flow 2

User Flow 3

Roya, 23 year old found herself alone in her apartment, now surrounded by floodwaters. As days passed, she became increasingly anxious when she realized her food and clean water supplies were nearly depleted. With all nearby stores closed, she was unable to replenish her stock. Then, she recalled that the local community center had assisted people in similar situations. Without hesitation, Roya contacted the center's members and requested help. The community center staff were courteous and supportive as they distributed food and water to those in need. Through the efforts of an official government volunteer, the community center was able to send Roya the supplies she desperately required. Grateful for their assistance, Roya was glad that she had already established a connection with the community center's members.

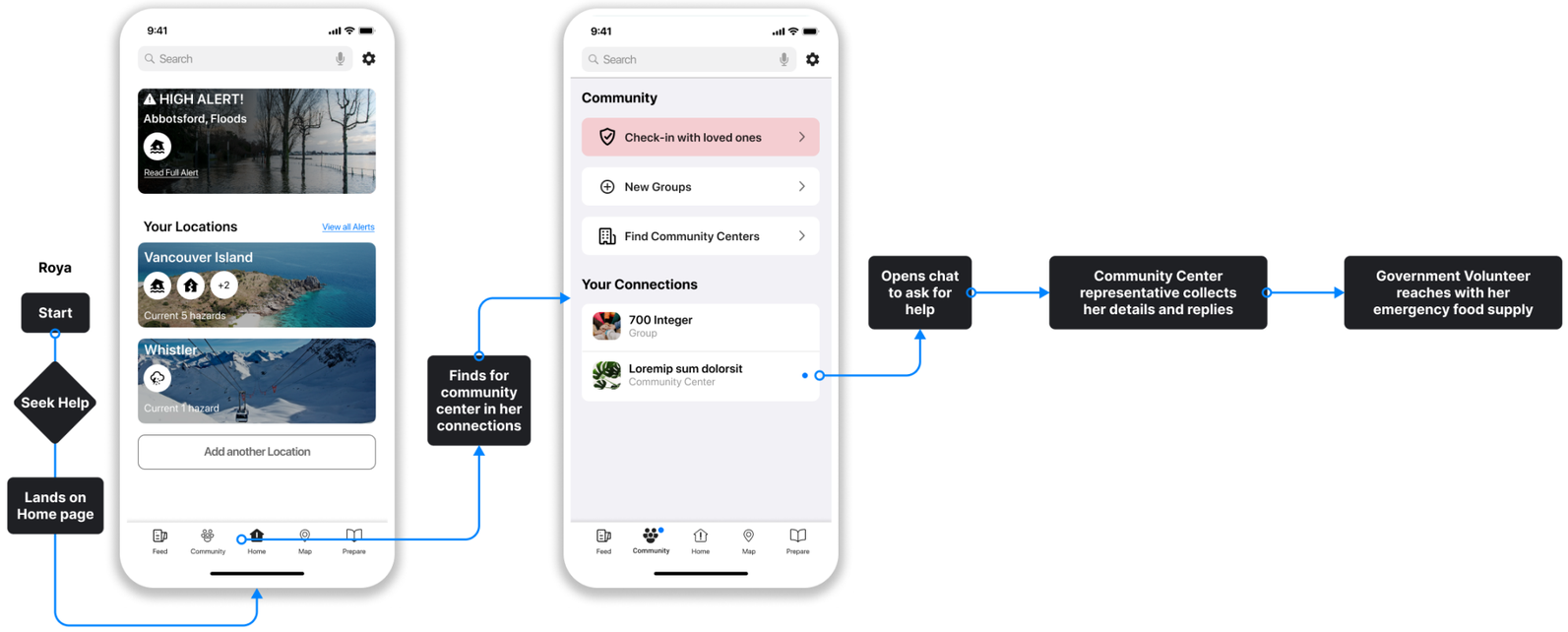

Figure B3: User Flow 3

User Flow 4

Isabella Rodriguez, a 47-year-old bank manager, had just returned home after a long day at work. As she settled in, and she browsed the Community Connect app for local updates. While browsing, she stumbled upon a post claiming that Victoria Street was closed due to a tree blocking the road. However, Isabella had just driven along that exact route without any issues. Concerned about the spread of misinformation, Isabella took immediate action and reported the post. By doing so, she helped prevent others from being misled by inaccurate information.

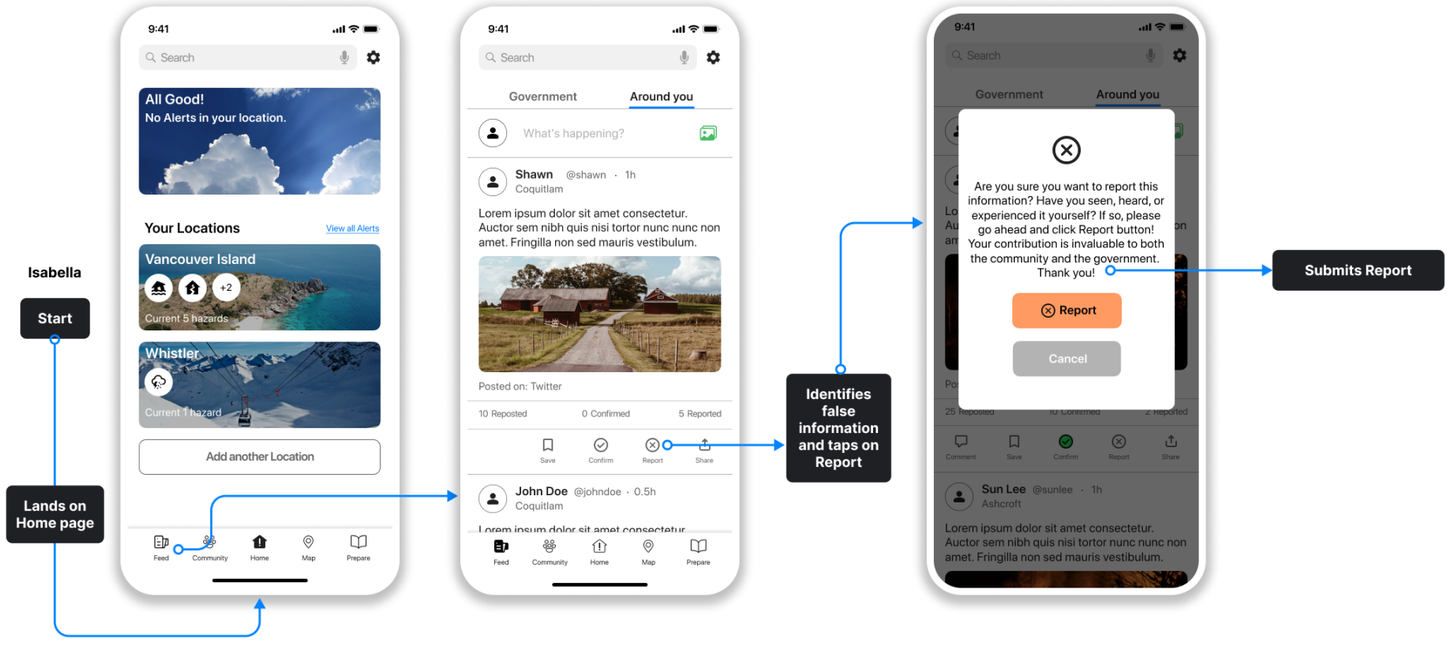

Figure B4: User Flow 4