Designing an Earthquake Preparedness Web Mapping Application for the Older Adult Population of Los Angeles, California

by

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To my wife and family for their patience and support during the process of this project.

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List of Abbreviations

AGOL	ArcGIS Online
API	Application Programming Interface
DHS	Department of Homeland Security
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
REST	Representational State Transfer
SSI	Spatial Sciences Institute
UI	User Interface
USC	University of Southern California
UX	User Experience
WPP	Wicked Problems Practicum

Abstract

One of the greatest natural disaster threats to the Los Angeles area is earthquakes. A large earthquake could wreak havoc on the area, causing major damage and loss of life. Recent research from disaster events has shown that older adults (those 65 years and older) are one of the most vulnerable demographics to disasters. Older adults benefit from specialized planning and preparation designed specifically for their demographic. As the older adult populations are rapidly on the rise in the Los Angeles area, the county and city have devised plans to prepare and aid the community with natural disasters, including earthquakes. As a part of this effort, this project was to research, design, develop, and test a prototype web mapping application for the older adult population of Los Angeles to better prepare them for earthquakes and increase their awareness of nearby emergency services.

This project brought together map layers of earthquakes hazards, emergency services, and shelters, and other mapping layers related to seniors such as senior centers and nursing homes into a single web mapping application. This project customized the web mapping application user interface and user experience design in order to make the application user-friendly to older adults. The developed web mapping application allowed users to zoom to their location, pan the map, identify map layers, turn on/off map layers, print a map, search for the nearest emergency services and shelters nearest their location, and add an emergency preparation needs point to the map. With the results of this project, progress was made with understanding successful and unsuccessful methods of apply UI/UX designs of web mapping applications for older adults. The results can be applied to future research in order to best meet the needs of older adults with web mapping applications.

Chapter 1 Introduction

With the older adult population of Los Angeles on the rise, the City of Los Angeles has been working to make plans in order to make the city a more age-friendly place to live. As part of those plans, the city has placed emphasis on disaster, and emergency planning for the older adult population as older adults are often the most vulnerable to natural disasters. With the city lying on some of the most active geological faults in the world, older adult Los Angelenos need to be prepared for earthquakes. The purpose of this thesis project was to design a geospatial solution to meet the needs of the aging population of Los Angeles in preparing earthquake disasters. The end goal of this research was the creation of a prototype web mapping application specifically designed for use by Angelenos 65 years of age and older in earthquake preparedness. An underlying goal was to research and test web mapping application User Interface (UI) and User Experience (UX) design methods for older adults within this earthquake web mapping application. This project was a novelty because there was no known web mapping application about earthquakes and earthquake preparedness specifically designed for older adults. An application would be very helpful in the process of preparation, awareness, and reporting for faster response. This project contributed to aiding society by researching the design of a web Geographic Information System (GIS) application for the older adult community to use in preparation earthquakes in the Los Angeles area.

The rest of Chapter 1 introduces the motivation, the study area, a brief application description, and the thesis structure. Section 1.1 details the motivation for this projection. Section 1.2 describes the study area. Section 1.3 provides a brief description of the application. Section 1.4 gives the thesis structure for the rest of the document.

1.1. Motivation

This section describes the overall motivation that pushed this research project. The two main areas that pushed this project was the need for assisting older adults with disaster preparation and the need for specialized design of application for older adults. The following subsections describe these motivation areas in more detail, giving background to the need for a web mapping application designed to help older adults with earthquake preparation.

1.1.1. Older Adults and Disasters

Older adults have been found to be more vulnerable to natural disasters, and older adults have also been found to benefit from emergency preparation planning gear toward them. Section 1.1.1.1 describes the older adult population vulnerability to disasters. Section 1.1.1.2 discusses background information for older adult preparation for disasters.

1.1.1.1. Older Adult Population Vulnerability to Disaster

Among those most vulnerable identified by studies such as the study of "Earthquake Preparedness in an Aging Society by Davey and Neal, are those of the older adult demographic of those aging 65 or older (Davey and Neal 2013). Research has found that older adults among those who are most vulnerable during and after earthquakes because of health issues and social issues that many in the age group face. Those in the older adult demographic are also more prone to be immobile and unable to evacuate on their own.

Brown and Peterson (2014) state that 90% of older adults often live in the community, and almost a third live alone. They also note that many suffer from immobility, visual impairment, mental cognition, diminished sensory awareness, and various chronic health events. They find that harm and vulnerability to older adults in catastrophic events are widespread. Despite older adults only making up 15% percent of the Gulf Coast population in 2006, 71% of those who died were of 60 years and older, and most of these died in their homes. In Japan, 56% of the fatalities from the earthquake and tsunami in 2011 were older adults. The chapter suggested that the issues lie with preparation and planning provided for the older adult community and that 0there is a growing need for specifically designed planning for their demographic. The overall population of those over 65 will double in the US, and the overall complexity and frequency of disaster events appears to be getting greater. The research points in direction of the to the heavy need for planning for vulnerable older adult demographic and points to some promising practices such as the Florida Department of Health creating a Geographic Information System database of older adult vulnerabilities and needs down to the zip code level in order to be better prepared to meet those needs and identify the older adults needs in an affected area (Brown and Peterson 2014)

The Age-Friendly Action Plan for the Los Angeles Region (2018) by the Purposeful Aging Los Angeles Initiative (comprised of Los Angeles public officials, the AARP, private sector, and universities) identified emergencies and disasters as a major domain to plan and prepare for in order to better preserve, prepare, and protect the lives of those of the older adult community in need. The plan states that the older adult community in Los Angeles is rapidly growing and would grow to 2.1 million by the year 2030. According to the California Department of Aging (2015), The Los Angeles County older adult population will grow 171.3% between the years of 2010 and 2060 (Figure 1). The growth would represent a major increase and change to the demographics to the area and causes major concern for the well-being of this growing age group. As this demographic grows, the needs of this group grow and the need to better prepare them for disaster as they will make up a larger part of the population. The Purposeful Aging Los Angeles Initiative with the Age-Friendly Plan for the Los Angeles Region

(2018) has made it a priority to plan to increase preparedness and plans for the older adult community in Los Angeles. In conjunction with this plan, The Wicked Problems Practicum (WPP) held in 2018 by the University of Southern California (USC) combined efforts from the School of Gerontology and from the Spatial Sciences Institute (SSI) to create geospatial applications for this effort and identified a great need in developing geospatial applications for the older adult community. This thesis project idea was born out of the author's involvement with the WPP in order to find a better solution for the older adults of Los Angeles. Section 1.1.1.2 discusses research into disaster planning for older adults, and the types of needs older adults have for disaster planning and what can be useful to them in order to be better prepared.

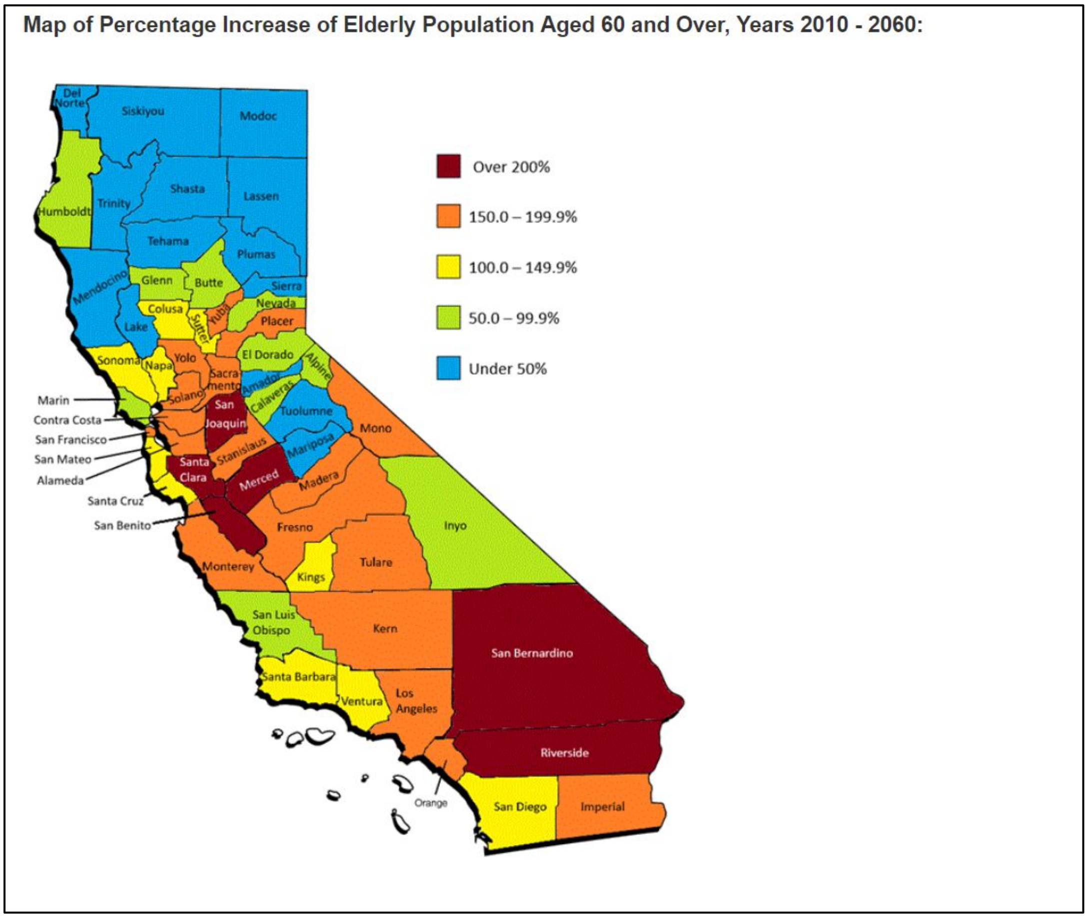


Figure 1. Anticipated Increase of Older Adult Population in California

(California Department of Aging 2015)

1.1.1.2. Preparation for Older Adults in Disaster Events

The Red Cross (n.d.) study, “Disaster Preparedness for the Elderly by the Elderly,” identifies several needs for the older adult community in order to be prepared for a disaster. Some of those needs are listed as medical supplies, food, water, batteries, dry clothing, transportation, and maps. Maps are important because they can show information on locations of stores for supplies, emergency services, and routes for possible evacuation (Red Cross n.d.). This document points out the need for preparedness designed specifically for the older adult community and the importance of having knowledge of one’s surroundings before an earthquake event.

The Department for Aging of Los Angeles web page provides several helpful documents of older adults in order to be better prepared for disasters. Within the helpful documents, the city lists several things to have on hand for emergency supplies for disasters. The items include bottled water, canned and dried foods, batteries, first aid kits, emergency kits, and other items. The city website also points to the importance of planning to know if to evacuate, stay in place, or arrange for transportation with those that have no vehicle or have mobility issues (City of LA n.d.).

In 2014, on the show “Aging Well in LA,” (LA City View 2014), the host Paul Peterson discussed the topic of emergency preparedness with City of LA officials and discussed how older adults could be better prepared. Petersen interviewed the Los Angeles Department of Aging head, Laura Trejo, and officials from the Fire Department and the Emergency Response Office. The city officials explained the importance of knowing shelters locations and having emergency kits ready to go. The city officials suggested that older adults are sometimes reluctant or have issues putting together emergency kits and evacuating without help. The emergency management official suggested that older adults needed to be prepared for evacuating with pets and to be aware of shelters that are pet-friendly. The fire department representative discussed the need for understanding routes and understanding maps and knowing what resources are available to older adults in their neighborhoods. The fire department official also suggested that knowing of the dangers and hazards will help the older adults be more aware and prepared. In another part of the interview, the city officials suggested that mobility issues and other disabilities that older adults have need to be planned and prepared for by officials, family, friends, and volunteers in case those disabilities and mobility issues need to be provided for (LA City View 2014).

1.1.2. Older Adults and Web Design

This section gives the background for need of researching and designing web mapping applications specifically for older adults. Section 1.1.2.1 describes the older adult adaptation to computer to computer technology and mobile phones. Section 1.1.2.2 introduces the reasons and need for specialized design of software applications for older adults. Section 1.1.2.3 introduces the need to design web mapping applications specifically for older adults.

1.1.2.1. Older Adult Adaption to Computer Technology and Mobile Phones

As time has progresses, the segment of the older adult population that is familiar with computer technology grows. More senior adults are being exposed to and taught the technology., and younger seniors are more likely to have been exposed to computers and smart phones before they officially joined the senior demographic. These older adults are more familiar with modern technologies. Pew Research numbers from 2017 show that around two-thirds of those 65 and older now go online and a record number of older adults are now using smartphones (Anderson and Perin 2017). The survey also reports that well over half of those over 65 now have broadband at home. According to the survey, over 58 percent say that digital technology has a positive impact on their lives and society, 75 percent say they go online on a daily basis. The

Pew Research does, however, show that some seniors are still disconnected. The survey also shows that the oldest adults in the population tested are less likely to use computer technology (Anderson and Perin 2017).

Research does suggest the heavy need for older adult users to be trained on technology, as 48% of those surveyed said they need training (Anderson and Perin 2017.) Barnard et al. (2013) also point to the need for training and education for older adult users. The study showed that working with computer technology helped with cognitive skills, but older adults were more likely to use technology successfully with help. This research points to the importance of working with older adults to design computer technology and training for them to help them better to understand the technology and programs.

Another Pew Research Center survey completed in 2015 looked at the US Smartphone usage (Smith and Page 2015). The study found that nearly two-thirds of Americans owned smartphones at the time. The survey also shows that over 68 percent of users use their smartphone for breaking news, and 67 percent use their phones for navigation now. According to the research, over 80 percent of users of 50 years and older use their smartphones for internet use which points to a large number of those over 65 using smartphones for internet use; however, according to the research conducted, only 27 percent of users in the survey were those 65 and older. These numbers, according to pew research, are a good reflection of the general population. (Smith and Page 2015). In February 2018, the Pew Research fact sheets showed a 46% increase in mobile smartphone usage by older 65 and up. The upward smartphone usage trend by older adults suggest that this trend will only increase as those who use smartphone technology get older and older adults are exposed to the technology become more comfortable with the technology (Pew Research 2018).

While the research points to a higher number of older adults of those 65 and older using the internet and mobile phones, there is still roughly just under half using smartphones. However, those in that quarter cannot be ignored. The numbers also show an upward trend in users. The research provided by the Pew Research Center shows that both computer browser-based applications and mobile smartphone applications should be considered moving forward. The research also suggests that using the internet for mapping and navigation that a mapping application could be useful and successful.

1.1.2.2. The Need for Software Application Design for Older Adults

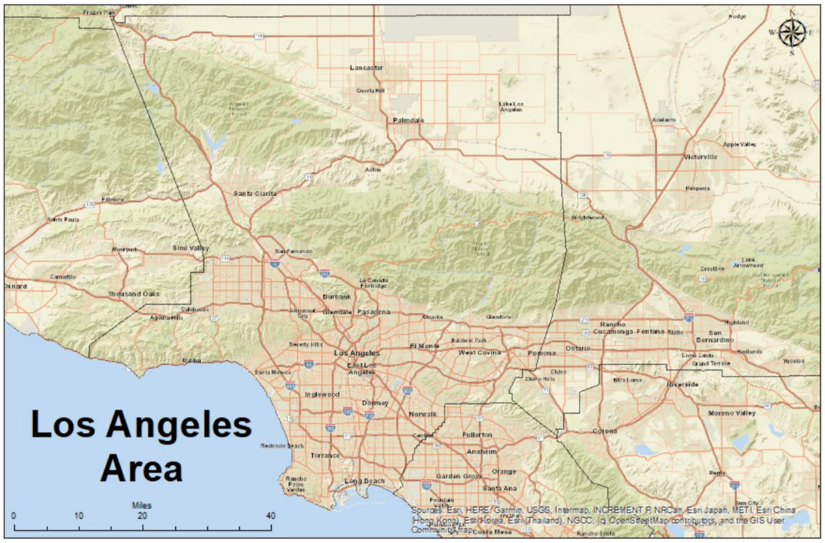
Most of the research for a design for older adults focuses on design for physical ailments that come with older age and stress the need for high usability. Most of the articles from magazines and journals that the author found pointed to designing applications for the older user that were not map based. Even though the articles are not map based, the information found in the articles can still be applied in this research. The articles point to making the application easier to use and that several applications do not consider older adults, but they should. Articles by Ollie Campbell in Smashing Magazine (2019) and Emily Grace Adiseshah (2016) on Usability Geek Magazine online both suggest designing fonts that are larger, buttons that are larger, high contrasting colors, easier to use navigation of buttons, and easily understandable language. In the book, *Designing User Interfaces* by Jeff Johnson and Kate Finn (2017), the authors make the strong claim that poor usability can lead to the desired audience not using the application. All of the research pointed to the need for designing an application for the specific needs of older adults. Their research also showed that if a mapping application was going to be designed, it should consider the things that would make it more user-friendly. Chapter 2 will go into more detail of the research into designing software applications for older adults.

1.1.2.3. Web Map Design for the Older Adult User

A few studies (Kovanen et. al. 2012; Veronko and Petrovic 2015) investigated different methods to improve web maps for the older adult user and the issues that they face with visual problems and aid. Kovenan et al. (2012), researched design of mobile web mapping applications for older adults looking specifically at plain cartographic design and color schemes that best fit older adult visual issues. Verenko and Petrovic (2015), researched online web maps focused on contrast and color for older adults. No other studies specifically focused on web maps design for older adults. The older adult population of Los Angeles is very much in need of an earthquake web mapping application design specifically for their community because other earthquake-related web mapping applications have not been designed specifically with those users in mind.

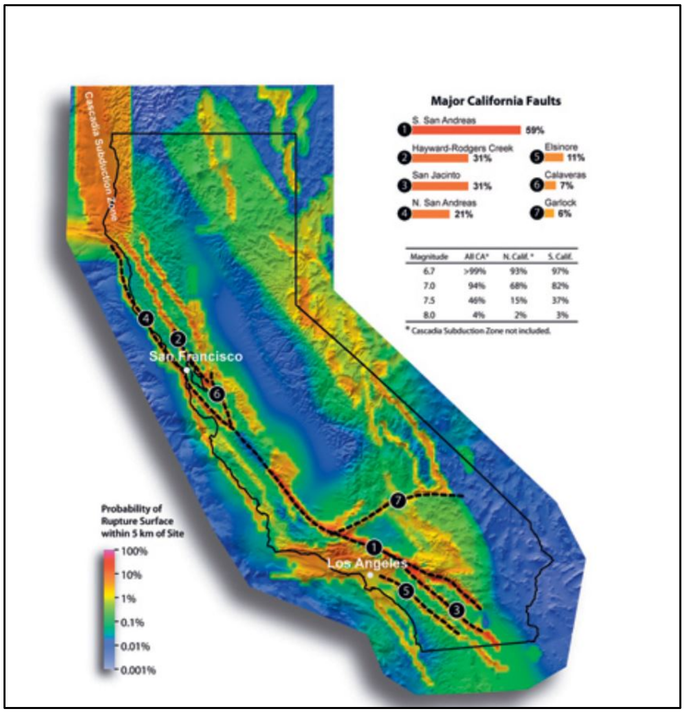
1.2. Study Area

The study area, as seen in Figure 2, focuses on the Los Angeles Area as the project coincides with efforts of the Aging Purposeful Los Angeles Initiative, which aids older adults in disaster preparation for earthquakes. Los Angeles is situated upon one of the most active fault areas in the world and has several minor earthquakes on a regular basis. The San Andreas is the more notable of the faults that are in Southern California; however, there are hundreds of other smaller faults in the Los Angeles area. The city itself is situated on six major fault systems. Based on research from the USGS, the area of Los Angeles is at high risk for having several moderate earthquakes or even a larger catastrophic earthquake (Figure 3).



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Figure 2. Study Area of Los Angeles



Magnitude	All CA*	N. Calif.*	S. Calif.
6.7	>99%	93%	97%
7.0	94%	68%	82%
7.5	46%	15%	37%
8.0	4%	2%	3%

* Cascadia Subduction Zone not included.

Figure 3. California Earthquake Probability (Southern California Earthquake Center 2011)

Scientific research suggests that Southern California is ripe for a major earthquake. While it has been several hundred years for a major earthquake to hit, the Los Angeles area has been subjective to a few damaging earthquakes in the moderate level and several in the minor level. It has been over 327 years since the last major earthquake hit Southern California; however, the area has been hit by earthquakes that are considered moderate earthquakes such as the Northridge earthquake that occurred in 1994 which caused major damage. The area has also been hit by several smaller earthquakes that have also caused damage. According to the USGS, Southern California has a 99.7% chance of having another moderate size earthquake of those between 4.8 and 6.7 on the Richter scale and 37% chance at having a major earthquake 7.5 or greater on the Richter Scale in the next 30 years. The research by Dolan et al. suggests that it is only a matter of time before another moderate or major earthquake occurs due to the build-up of major seismic pressure and natural release of that pressure. (Dolan et al. 1995)

With earthquakes come hazards such as tsunamis, landslides, fires, building collapse, gas leaks, water pipe ruptures, electric outages, and many more hazards that are life-threatening. The document from the USGS suggests that a major earthquake for Southern California could be a Hurricane Katrina type of disaster for Los Angeles with the amount of destruction possible. The threat of an earthquake and the damage that they can do should be considered a major threat and should be planned and prepared for by all those in the Los Angeles area especially those who are most vulnerable (Southern California Earthquake Center 2011).

1.3. Application Description

The EQ Prep App was designed to allow easier user and interaction for older adult users. The application was built on the Esri ArcGIS Application Programming Interface (API) for JavaScript using the Web AppBuilder framework and presented to the intended older adult users via a web browser on whichever device that they chose to access it on so as long as the device can access the web. The application was designed to allow the user to interact with the map with several different widgets. The application was design to allow users to pan, zoom, and find their device location on the map. The users can identify map features by clicking on them and by checking the legend widget. The EQ Prep App was designed to allow users to turn on and off map layers and add points using the add assistance request points. Users can also print a screenshot of the map using the print widget and find the nearest emergency services and shelters to their location use widgets that will find those nearest features from one to five miles away.

1.4. Thesis Structure

The rest of this thesis is comprised of organized chapters, sections, and subsections that discuss research, design, development, results, and conclusions from the EQ Prep App project. Chapter 2 discusses research related literature and related existing applications that were used in order to provide a basis for the requirements for the application. Chapter 3 details the requirements for the application. Chapter 4 describes the data and methods used to develop the map and base application. Chapter 5 details the process of customizing the application. Chapter 6 shows the results of the application and application test. Chapter 7 discusses the issues found with the data, results, and provides a discussion on ways forward for the final application and future research. Chapter 7 also offers the final conclusion for the thesis project.

Chapter 2 Related Work

This chapter explores related research and development to understand better the need for a web mapping application to support the older community of Los Angeles. The first section describes research on application design for older adult users. The third section discusses web mapping user interface and design and cartographic design research for the older adult user. The third section examines existing web applications for disasters and earthquakes. The fourth section gives background information into the use of volunteered geographic information (VGI) in GIS systems for emergency disasters and relates to the use of VGI input by older adults in the web mapping application. Collectively, this work points to the need for a web mapping application development designed for older adults for earthquake disasters and the considerations that need to be made when designing the application.

2.1. Application Design for Older Adult Users

Several articles that the developer found while researching design for older adults pointed to the specific needs that older adult users have and the need to design applications specifically for older adults. The articles discussed what some of the issues were and the best ways to address those for older adult users to make apps for user-friendly for them. The ways to address these issues were used as key considerations for this project in the design of the application.

Campbell (2016) argues that people in the tech world that design applications often forget about the older adult generation in their work. The author urged the reader to realize that the older adult population is growing and need more attention given to the design of application to older adults. The author describes the need to design for older adults because of issues with vision, called presbyopia, that makes it difficult to read things up close. The author also says that as people age color vision declines, making it harder to see making things such as different shades of blue harder to see. The author suggests when the design for older adults to use a minimum of 16 font and use high contrast ratios in text and color to help with vision problems. The author also mentions the need for attention to design for the interface with screen size being considered. The screen sizes should be larger and avoiding smaller screens. The author suggested buttons of at least 44 by 44 pixels where they could be applied. The design of application for older adults had to consider older adults being able to interact with touch screens and using a mouse to click.

Adiseshiah (2019) offered some key tips when designing for older adults. The first was to make the application reader friendly. In agreement with Campbell, Adiseshiah suggested that developers make the font as large as possible with never going below 12-point fonts for any text. The author also indicated that the developer should put larger texts into the design even though some devices will let users change text themselves. The author described that not doing so could cause issues when older adults are forced to manually override sizes in applications because the device may not be able to change everything proportionally. The author also agrees that high color contrast is important for visibility and readability as well as clear language. Adiseshiah went on to say that the buttons also needed to be easier to click with buttons being at least 41px where applicable.

Johnson and Finn (2017) point to the necessity of designing for older adults in order to make applications more user-friendly. The authors found older adults to be more likely to take longer to learn to use an application. They also found that older adults are more likely to have issues with finding targets on the screen and have more issues with accidental movements or clicks with a mouse or touch screen. All of those things have to be taken into consideration when designing the interface of an application for older adult users. The authors also mention several things that have to be considered with eyesight with screen brightness, color contrast, and font style. The authors pointed out that designers often only think about font size but not color and font. The authors recommend using san serif fonts that are not light in width and do not use all capitals in body text, but titles are ok. Limiting the number of things on the screen was also a recommendation listed by the authors that needed to be considered. The authors also indicate the need to highlight by using larger text, different colors, and bold fonts for important items to make them stand out.

All of the research into designing applications for older adults was found to be helpful in building requirements for the application design. The requirements for the application are further discussed in Chapter 3 using many of the principles found in the research mentioned in this section and in the next section. The next section discusses research into the design of cartographic web applications for older adults.

2.2. UX and UI Web Mapping Design for the Older Adult Population

One of the key features of this study is the attention to detail of the design of mapping application for the older adult population. While there are several factors that must be considered when designing web mapping applications, older adults, there are few articles that address the creation of web mapping applications for older adults. This issue needs to be highly considered as older adults have issues that may make certain parts of maps, user interface, and user interface harder to understand and see. A few articles also address cartographic design and mental map cognition for the older adult.

Kovanen et al. (2012) argue that a growing number of the older adult population have some issues and inabilities when it comes to reading maps, especially mobile mapping applications with smaller displays. The research suggests that there are too few studies that address the issue of making maps and mobile maps to be understandable and readable for the older adult user. The study suggests making maps with “plain language” as a way to make maps easier to understand. The authors argue that creating simpler maps make them easier to understand by the older adult user. The older adult user tends to find maps with more information are harder to understand and overloaded with information. The authors also suggested that the best option for helping the older adult community understand maps is to make maps specifically designed for their community that can address issues that they face with understanding and reading the maps. The authors came up with the concept of “plain cartography” in order to address the issue of creating simplified maps designed specifically for the older adult user. The study aimed at creating principles in order to find a balance between visual clarity, information density, and including certain map levels for the understanding of associability. The study suggests making maps with more contrast and highly considering the font types and styles that are being used within the maps. Halos were often used in the research in order to provide color contrast to help differentiate labels from background layers. The change in colors and high contrast made the elements easier to see for those for visual issues. The study also suggests working with levels for symbology to decide what the most important layers are so that the symbols may be easier to understand and not overcrowd the map with information. The authors make the case that simplifying the symbology by leveling different elements makes the maps easier to understand. The authors also argue that the high contrast in the maps makes the different elements easier to see for those with visual impairments, which is common in older adults. The last thing that the authors pointed to was that design of web mapping applications for mobile devices is difficult because mobile device screen sizes are often smaller and present that present challenges to make features more visible on the smaller screen (Kovenan et al. 2012).

This study is most informative about the design to consider in mapping for the older adult community that will be employed in this study. This study also points to the need for designing maps separately for the older adult community.

Vrenko and Petrovic (2015) suggest that as the older population grows, more attention needs to be paid to those users in the design of the web map viewer. The study argues that with the limited visual ability of many older adult users, more thought should be given to the size of text and colors used by the design of web maps. This study also suggests that attention needs to be given to how web map layers will contrast and pop off of the map that makes the requested information easier to see. Mobility was also another issue noted by the study that some older adult users may not be able to use a mouse easily or be able to zoom in certain functions with their hands. Another issue is the ability of cognition, and the study suggests making the map easier to understand. The authors go on to mention that the three main components of visualization that need to be addressed are data, graphics, and interface. The study suggests that brightness also has to be considered as a key concept as the map interface needs be easy to be seen as well as map layout design has to be considered (Vrenko and Petrovic 2015). While this research does not specifically address making web mapping applications for earthquake disasters, the research does provide vital information for this study to consider in research and planning the design of a mobile mapping application for the older adult. The study also backs up the Kovenan (2012) study by describing the need for maps to be designed specifically for the older adult user.

2.3. Web Mapping Applications for Earthquakes and Other Disasters

Web GIS applications have played a major role in supporting natural disasters, including earthquakes for several years. Organizations such as the Federal Emergency Management

Agency, the Red Cross, the United States Geological Survey, the United States Army Corps of Engineers, and the California Geological Society all have used GIS applications in awareness, response, and recovery of natural disasters. Several of those organizations also have created web mapping applications, with success tracking earthquakes, displaying earthquake hazards, and showing shelter information for users and emergency officials. Efforts by private groups have also proven effective in providing web mapping applications for crisis situations.

The Federal Emergency Management Agency (FEMA) provides a web mapping application for identifying shelters which can be used in a disaster. The application only tracks shelters locations and federally declared disasters and does not include other earthquake hazard layers within this application for earthquake awareness. The FEMA web mapping application viewer is built on the Esri platform, employing in a plain, out-of-the-box Web AppBuilder format. The application shows locations of open and closed shelters and the different types of shelters available to users. Users can zoom to their location if the browser is able and see if any shelters are near their location. While this application is useful in showing shelter types and which shelters are open and closed and their location, this application lacks the ability for users to route to those locations or search for one that is nearest. Currently, the user would have to do that based on pure personal observation. The project plan for the earthquake awareness and response application designed for the older adult user was to allow users to see these same shelters, but also allow them to be able to route to those shelters and find the closest one to their location by use of a widget. The FEMA application does not also provide any additional data layers such as earthquake locations, faults, or hazards zones (FEMA n.d.).

Several web mapping applications have been developed to address the disaster itself. One such application is the United States Geological Survey (USGS) Earthquake Viewer. The USGS

Earthquake Viewer is an open sourced format web map viewer designed to show recent and historical earthquakes. The web mapping application is also designed to show faults and general hazards zones. While the earthquake viewer is one of the best applications for finding information directly related to earthquakes, the earthquake viewer lacks other layers related to disasters such as emergency services and does not allow for any user input such as adding points for preparation requests (USGS n.d.).

The American Red Cross has a multitude of mobile applications related to disasters, including earthquakes. The earthquake application includes very helpful information for what to prepare for and tips of what to during and after a quake. The user also has the ability within the application to add information for an unknown event. Users can also use the application to take quizzes on the preparation, knowledge, and planning in order to make sure the user understand the information being given. The application will also alert the user if a nearby earthquake has occurred. The mapping portion of the application provides mapping layers of recent earthquakes, radar, clouds, Red Cross shelters, and people that are in your shared group list. The application provides a very good model for an overall mobile application not just for mapping; however, the mapping portion does lack functionality and layers that would be more useful for an earthquake preparedness application designed for the older adult user. The map only allows one layer at a time to be on, which would not be useful to someone trying to see layers for shelters and evacuation routes at the same time. Since the application focuses only on the shelters and earthquakes, several useful layers are lacking such as earthquake hazards, fault locations, emergency services, senior centers, nursing homes, and other layers important to older adults (Red Cross 2018).

Another web mapping application project through the USC was designed and built for earthquakes within the Los Angeles area. McPherson (2016) completed a thesis research project developing an earthquake web mapping application for the students of University Park Campus. The research project centered upon creating a web map viewer of earthquake information in order to test the effectiveness of web mapping application for earthquake awareness and preparedness as compared to the static map. The mapping application contained layers for building locations, emergency supplies, assembly areas, and emergency disaster routes. The application was built using Esri's Web AppBuilder through ArcGIS Online (AGOL) which allowed a simple, easy design. The application included a very helpful tool called the "Locate Nearest" widget that allowed for a user to set a location and buffer area to find the nearest supplies. The type of analysis is very useful to the plans for this research project. While McPherson's study only compared static maps against the dynamic web mapping application, this study provides a very good guideline for designing an application using Esri's web mapping application for earthquake preparedness. The application was missing several pieces for user input of information to add to the data on the mapping application as well as actual recent earthquake information and the hazards. Also, the application was designed as for the intended use of those in the campus area and did not include any study into the creation for an older adult user and the methodology to incorporate the needs of many older adult users (McPherson 2016).

The Shake Alert LA application is a native mobile application that was unveiled in 2019 (City of Los Angeles 2019). The application has different button functions for preparing for an earthquake, earthquake alert map, view recent earthquake, and recover for an earthquake. The application shows recent earthquake on one screen. The application can alert you if an earthquake is happening in your area. The application provides preparation information on what to prepare for and how to prepare for an earthquake, and the application provides tabular information about what do related to post-disaster recovery. The application does not provide a visual information map with multiple earthquake hazard layers, shelter layers, and emergency service layers all in the same map that the users can visually see. It also only provides the information post-earthquake showing open shelters. The application does not show all shelters and emergency service locations in the preparation part of the app. The application design in this project does not have a documented preparation page showing helpful hints. The application design in this project also does not feature in post-recovery parts as this project was focused on the design of preparation web mapping application. While the Shake Alert LA application is design for multiple user use, it does not appear to be designed with the older population user as the foremost user. This project was ongoing at the time of the release of this application, and the developer compared design plans against this application for best practical uses. As this application was a native mobile application, not many considerations were taken into account. The designed application in this project was browser based. The application design in this project met other criteria and desired results than the LA Shake Alert application (City of Los Angeles 2019).

2.4. VGI and Crowdsourced Information for Disasters

VGI, as a part of GIS, has begun to play a major role in providing real-time locational information in disaster situations that is vital as time is of the essence in disasters (Goodchild and Glennon 2010). Efforts after a Haiti Earthquake used VGI and crowdsourcing from social media with great success to create geographic products used in response (Zook et al. 2010). A volunteer GIS group by the name of Standby Task Force also has successfully created Esri web mapping applications to be used by emergency officials and general public for emergency response in situations with Hurricane Maria in Puerto Rico, an earthquake in Nepal, and several other disaster events mashing up information related to the emergency and crowdsourcing social media for information on road closures, outages, and needs.

The term “volunteered geographic information” was coined by Goodchild in 2007 as a phenomenon of user-generated geographic information. Goodchild describes certain efforts such as OpenStreetMap and WikiMapia that use the general public in order to create geographic data and update the information (Goodchild 2007). Goodchild continues on in a later study to understand the user of volunteered geographic information for disaster events. Goodchild explained that while there are some concerns with data quality that the speed at which data can be collected from those citizens on the ground is far outweighing. He argues that the volunteered geographic information method as a good alternative to other procedures of data collection through agencies and emergency management groups. In another article in 2010, Goodchild observed the use of the volunteered geographic information for wildfires in southern California and found that never before had the citizens been able to be so involved before with the reporting efforts and be able to see the information so quickly (Goodchild and Glennon 2010).

One good example of the usefulness of volunteered geographic information in an earthquake disaster occurred after the Haitian Earthquake in 2010 (Zook et al. 2010). Volunteers collected information and sent it to emergency management groups. These groups then shared it to users sitting all over the world to update maps with satellite imagery for the island of Haiti. This effort proved very promising as the detailed maps of the area desperately lacked updates and availability. The effort also comprised of programmatically scanning social media post in order to crowdsource for information of those who were trapped under rubble or in need of help and using social media to call for help. The crowdsourced information was then mapped based on the geotagged information in the social media post. This information was vital in aiding emergency responders to find individuals faster that they might not have otherwise known were in need assistance (Zook et al. 2010).

Over the past few years, a volunteer group by the name of Standby Task Force has worked to develop several web mapping applications for disaster events for hurricanes and earthquakes to provide real-time information to emergency officials of the situation on the ground. The work completed by Standby Task Force created web maps that took crowdsourced information from social media and created an awareness map for the public and emergency officials to use to see where people may be trapped, or road may be cut off or damaged. The Nepal Earthquake map was an excellent example of the work completed by the Standby Task Force to aid in the earthquake in relief and how a volunteered web mapping application could aid in the relief of earthquake victims and allow those affected to aid in their own relief efforts (Standby Task Force 2015).

Although these systems used volunteered geographic information and crowdsourced for more information, none of these systems and studies researched designing a GIS system that allows older adult users to provide VGI. These studies and systems proved that crowdsourcing and using VGI can be very helpful and give background and reason to giving the older adult user the ability the interact with a system to provide VGI.

Chapter 3 Application Requirements

This chapter discusses the requirements for the web mapping application. Sections 3.1 and 3.2, respectively, identify application interface design requirements and functionality requirements. Section 3.3 discusses map design requirements. Section 3.4 discusses map content requirements. Section 3.5 discusses the software requirements for this project.

3.1. Application Interface Design Requirements

With the intended users of this application being older adults, the application interface had to meet certain design requirements based on previous research provided in chapter 2 for older adult web applications and web mapping applications. When designing web mapping applications for older adults, the design had to consider some physical and mental limitations that affect many older adult users. Many older adults suffer from visual impairments such as color blindness and limitations being able to see the small font and certain fonts. Many older adults also suffer memory and mental processing issues. The design of this project had to consider those limitations with the design of the application.

The first thing that the design of the application had to consider was text. The application had to have large enough font that could be clearly be read. Based on conversations with Dr. Caroline Cicero from the USC School of Gerontology and Laura Trejo from the Departing of Aging with the City of Los Angeles, a minimum font of 14px should always be used but the larger the font, the better. Some of the research suggested using at least 16px. Font style also played a key role in being able to read font on the screen. Based on this information, key requirement number one for application interface design was to make font sizes at least 14 pixels for the application. Requirement number two for application interface design was to use sans serif fonts. According to several of the researched articles on the best fonts to use, San serif fonts are more clearly legible for users in general to read but even more so for older adults. The third requirement for the application interface design was to used contrasting font colors for text. Font color that is a clearly contrasting font that shows up better against backgrounds was also a requirement for the application.

The second thing to consider in the design requirement was the size of the application buttons. The fourth requirement is that the design of the application buttons had to be designed to be larger. Larger buttons are easier to find and click for older adult users. Based on the literature and design review for older adults, buttons should be made for ease of clicking the buttons. Making buttons larger is even more important for applications can be accessed via a device that is touch screen enabled. The button must be made wider so that a finger or stylus can easily touch the button. Buttons should be made larger and at least 41px in places that could be done that way. Hardware and software limitations would have an effect on some of the sizes of the buttons chosen.

The third thing that had to be considered in the application requirement was the contrast in color of application elements. The fifth requirement for the application design requirements was for the application to have high contrast in colors between elements that could be easily seen. The application had to have a color theme that had a high color contrast between elements. Colors that are close in color were not to be placed together. The application design also had to consider colors that are not on the same color scale for color blind impairments as there is a higher number of people with color blindness that are older adults. Colors that are often misinterpreted due to color blindness were not to be used together in the application development.

The fourth thing that had to be considered was the ease of navigation of the application. The sixth requirement for the application design was that the application needed to be designed with a simplified design and theme that was easier to use. Having all of the application widget buttons on the web page be easy to find and near one another allows for easier navigation of the application and makes it easier to use. Buttons that are spread out and on multiple places on the screen makes the application harder to use and navigate. Buttons also needed to have icons that are easily recognizable or make the connection for what the button performs.

Based on the concepts and of the need to design the application for the older adult users, six total requirements were found: 1. Use application font sizes of 14px or greater, 2. Use san serif fonts throughout the application, 3. Use font colors that will contrast well with the background. 4. Make buttons larger to be easier to pick. Make buttons at least 41px by 41px where possible, 5. Use high contrasting colors between elements, 6. Use simplified application navigation design.

3.2. Mapping Application Interaction Functionality Requirements

The requirements for the application functionality of the mapping application were based on previous and research by the developer for earthquake preparation web mapping application and functionality that would be important for older adults in an earthquake.

The basic web map interaction capabilities of panning and zooming were an important functionality to include. Users needed the ability to be able to look at a location on the map and choose different views of the map. Users needed to have the ability to zoom in to see more detail in the mapping application to be able to see different features. The users also needed to be able to zoom out of the application when necessary to see more features further out. Users also needed to be able to pan or move around the map to look at different areas at different zoom levels.

Based on the needs of the users mentioned here, the first requirement of the mapping application functionality was to give the user the ability to zoom in and out and pan the map.

The second requirement of mapping application functionality was adding the ability for the application to zoom to the user's location on the map. Users needed to be able to center the map on their location so that they could see the map features nearby or further interact with them. Because the purpose of the mapping application was to be used for earthquake preparation, users needed the ability to find their location on the map and use their location to find out more information about the area around them in order to be more prepared for an earthquake.

The third requirement of mapping application functionality was to have the ability in the application for users to identify map features. Users needed to be able to get more information about the area and map layers. The mapping application needed to have the ability for users to identify map layers and information about map layers. The mapping application needed a legend to clearly identify what layers were and how the layers were symbolized, and the application needed the ability for a label or popup to identify the map layer and information about the layer.

Based on conversations that the developer had with Laura Trejo with the City of Los Angeles Aging Department, the fourth requirement for application functionality was for the ability to be able to print to be added to the functionality of the application. Users needed the ability to print the map view from the screen in order to have a copy of the map at a later time if they were unable to access the application in the case of an earthquake event.

The fifth application functionality requirement that was added to the list for application functionality was the ability to add a point to the map. The developer wanted to test the process of allowing the older adult users to interact with the mapping application to be able to provide data to the mapping application. During previous disaster events, the use of VGI had been found to be useful for emergency officials in being able to provide more efficient support. Because of the application intended use of earthquake preparation, the users needed to be able to add a point along with their specific preparation needs.

The sixth application functionality requirement was the ability for users to easily find nearest shelters and nearest emergency services. The users need the ability to find these quickly using the system to find the nearest by distance rather than just choosing visually. Users need to be able to locate all the nearest shelters and see their distances and names. Shelters and emergency services are important places to know the location of in case of a disaster event. Being able to locate those places and being able to find the nearest ones near an application user's location was an important part of the functionality requirements. Being able to quickly locate nearest shelters, allows the user to make plans based on what the closest shelters and emergency services are to their location.

3.3. Map Design Requirements

For this project, the map in the application was dependent on parameters used for mapping for older adults, emergency hazards, and commonly known symbols for places. Prior research, discussed in Chapter 2, identifies basic concepts for map and layer design that steered the requirements of the map design.

The first basic concept was simple map design. Map layers can be simply symbolized and set to be scale dependent so that multiple layers aren't all provided at once. When too many map symbols are showing up and covering up the map, the map is harder to understand and read. The first part of the concept is to decide what map background layers are most important to map for reference and which can be left off to help simplify the map. The first map design requirements were to simplify the map background and the map layers that were added on to the map. The map needed to include based reference guides such as roads and familiar places, but also the layers needed to be simplified by not breaking things out into so many classes and turning layers to be set to turn on at different scales.

The second basic concept was providing high contrast in colors. This fit into the second requirement of the map design. The map needed to have contrasting colors that could be seen similar to the requirement of high contrast in colors for the application. Some older adults cannot distinguish colors that are near the same hue and near each other on the map, which could cause separate map features to blend together and appear continuous. Higher contrast in color between map features make the different features "pop" and be seen more clearly.

The third basic concept was to use larger text with high contrast within the map for labels. This concept made the third requirement of the map design. Labels for map features that use larger text makes map text easier to read for older adults that have vision impairment. For the same concept of contrast, the text needed to be clearly seen and not blend with the map layers. The fourth map design requirement also be of the san serif font because serif fonts are harder to read within web applications.

The fourth basic concept was to make symbols easily understandable, or intuitive. This concept was made the fifth map design requirement. Symbols needed to be larger than typical symbols so that they could be clearly seen. The symbols also needed to be familiar symbols that are often used for map features of that type so that the map features could be easily identified.

3.4. Map Content Requirements

In order to know what map layers needed to be included or excluded in this mapping application, requirements were set for what needed to be included. Based on the simplification concept mentioned in the previous section, part of the research for this project included finding the “happy medium” of the right number of layers for the application. For this project, there were five different classes set for the layers by author: earthquake-related layers, emergency services, shelters, preparation needs assistance requests points, and other reference layers that older adults might relate to or be familiar with such as senior community senior center and nursing homes. Section 3.4.1 discusses the earthquake-related layer class requirements. Section 3.4.2 discusses the shelters class requirements. Section 3.4.4 introduces the emergency service class requirements. Section 3.4.4 describes the preparation needs assistance request point class requirements. Section 3.4.5 discusses the senior reference layer class requirements.

3.4.1. Earthquake-Related Layer Requirements

Since this application was designed for earthquake preparation, earthquake hazard related layers were decided as required for this application. Users needed to be able to see earthquake hazard layers in the map. Due to the concept of simplification, only certain earthquake hazards would be required. Overall, earthquake hazards would not be required as the entire Los Angeles area is in a hazard area. Because this mapping application was designed for earthquake preparation, live earthquakes or past earthquakes were also not a requirement. For this application, liquefaction areas, landslides, and the fault lines were requirements for the earthquake hazards. The earthquakes hazards would help the users be able to identify if their area was in or near an earthquake hazard area.

3.4.2. Shelters Layer Requirements

For emergency preparedness and planning purposes, the project research identified shelters as important layers that were required to be a part of this application. Designating the shelters that were wheelchair accessible was also set as a requirement as the shelters needed to be identified that were more accessible than others as more adults suffer from mobility issues and would need more accessible shelters.

3.4.3. Emergency Services Layer Requirements

For emergency preparedness and planning purposes, the project research also identified emergency service location as important types of information to have included in the mapping application. For the emergency services, hospitals and urgent care facilities were decided as requirements as those emergency services would be the more important emergency services as compared to pharmacy and normal primary care facility locations. The emergency services would also be limited to just hospitals and urgent care facilities for the simplification concept.

3.4.4. Requirements for Preparation Needs Assistance Request Layer

In order to allow for the older adults to contribute to their own preparation of earthquake and interact with the map, the preparation needs assistance points were required for the application. Giving the ability for older adults to place a point on the map with a preparation needs assistance request would allow the older adults to place points on the map with various needs that could be used by the city to stage supplies and assistance to those of the older adult community to help them prepare and make plans for an earthquake emergency. Older adults could request the need with assistance for batteries, preparation training, canned good, bottled water, pets, transportation, emergency kits, or assistance. Conversations with those in the emergency field and gerontology field in Los Angeles, documents from the Red Cross, and the LA Age Friendly Action Plan all supported need for the ability for older adults to interact to be involved with preparation planning and requests. Literature supported that volunteered geographic information was very useful in planning and preparation for emergency events.

3.4.5. Requirements for Senior Reference Layers

Gerontology experts suggested adding nursing home and senior centers to the map as these could serve as helpful reference layers for older adults. First, older adults might find nursing home locations useful because they either might live in nursing homes or have friend that live at those locations and may be familiar with those locations in reference to roads and other landmarks. Second, older adults also might often visit senior community centers, and activities are also held at these locations for older adults. These reference layers may help older adults navigate the map and be able to relate to locations based on those layers.

3.5. Software Requirements

In order to be able to develop a web mapping application for earthquake preparation for older adults and test the UI/UX design, software requirements had to be met that were able to meet the project requirements. First of all, the application would have to be built using software that was accessible by anyone via the web on multiple types of devices. Second, the application would have been accessible on multiple browsers because many users would use different browsers. Third, because of the need to have points created, a software would have to be used that could create geographic data. Fourth, the software would also need to push data to the web. Fifth, the application software would have to be able use web data rather data on the device itself. Sixth, the software platform chosen would need to make the transition from offline data, to web services data, to web map, to web mapping application, to customized web mapping application, and then to the web server. Seventh, an API would also have to be chosen that could meet functionality requirements and UI customization requirements. Eighth, software would have also to be chosen that could be used to meet the customization requirements and push the web mapping application to the web server. Chapter 4 will discuss the software chosen to meet the requirements for software laid out here.

Chapter 4 Software, Data, and Base Application Development

This chapter will detail the software chosen, the data chosen along with sources, and the methodology that was performed to develop this application. Section 4.1 describes the software chosen for this project based on the requirements. Section 4.2 details the data chosen and included in the application. Section 4.3 examines the methods by which data schema creation that needed to be created was done for the VGI data layer. Section 4.4 discusses the method by which the base map was created. Section 4.5 details the map creation. Section 4.6 reviews the process of development for the base application functionality and design.

4.1. Software

This section describes the choice of the Esri platform overall and particular programs within the Esri suite of options for application development. Section 4.1.1 discusses Esri for Desktop. Section 4.1.2 describes REST Services. Section 4.1.3 gives information about AGOL Web Maps. Section 4.1.4 provides information about AGOL Web AppBuilder. Section 4.1.5. discusses Web AppBuilder Developer Edition. Section 4.1.6 describes Esri efficiency for ease of transition of data content to the web mapping application.

4.1.1. Esri For Desktop

Using the Esri software platform offered the ability for ease of transition to go from data creation all the way to a finished product all using the same platform and ArcGIS API for JavaScript. The software allowed any necessary layer creation to be made in ArcGIS for Desktop. The data schema for the assistance needs request points could be created in ArcGIS for Desktop. The querying of data and data extraction could be done in. ArcGIS for Desktop could also be used to push data layers to the web by creating REST services that would be hosted either on AGOL or an ArcServer.

4.1.2. REST Services

REST stands for Representational State Transfer, and REST is a type of the architecture for a web service. REST services are often used for web GIS data and fit the requirement of web GIS services. All of the data used in the project were available through REST services. REST services could be served directly to the AGOL map from either servers directly within the Esri AGOL environment or from servers ran by other companies or agencies.

4.1.3. AGOL WebMaps

Esri also offers the ability to build out a map within the AGOL environment pulling from all of the REST services as map layers and allows for some customization of the symbology, transparency, labels, and scale of the map layers. The online mapping platform could allow to set the levels of the layers and bring in customized map backgrounds. The Esri AGOL platform map could also be used to query data. The map in AGOL could then be easily made into a mapping application using Web AppBuilder wizard.

4.1.4. AGOL Web AppBuilder

Web AppBuilder is the built-in web mapping application development tool that Esri supplies with AGOL. Web AppBuilder allows for the ease of taking a map designed in ArcGIS to web mapping application in just a few steps. The Web AppBuilder tools allow for the adding of simple widgets to meet a variety of functions to interact with the map. The widgets can be configured in the online Web AppBuilder, and certain packaged themes can be applied. The app could then be released as is or it could be exported out to customize or imported into Web

AppBuilder Developer edition for further customization of themes that the online Web AppBuilder does not allow

4.1.5. Web AppBuilder Developer Edition

Web AppBuilder Developer Edition by Esri allows for the further customization of themes and codes that can be applied to the code. Web AppBuilder Developer could take application started in Web AppBuilder in AGOL and allow for important that application and organizing the code. If an application is directly exported from AGOL, the code is not organized and recognized as the type of code it is by code editing software. The Web AppBuilder Developer software allows for the code to be important and organized as well as customized themes that could be applied to multiple applications.

The application could then be exported so that further code editing directly to that application alone and the code to apply to several applications. The Esri ArcGIS API for JavaScript is set up to support customized use of Esri tools, and for developer applications to be registered and rehosted on another web server. Changing all the code using the Esri API for Java Script was more advantageous because the code be changed directly to the application itself rather writing large amounts of new code to create new widgets and other map interaction. The code was already in place and only had to be customized around the previously developed Esri Web AppBuilder framework.

4.1.5.1. Code and File Customization Software

Adobe Dreamweaver and Photoshop were chosen as the software to write and customize code and photo files. Dreamweaver allows for a local site to be set up to organize files and how they appear on the remote web server site. Dreamweaver also allows for the application code to be edited and published to a web server. Firefox inspector tools were used to identify specific code that needed to be changed in the application.

4.1.6. Esri Efficiency

Using the Esri software platform, Web AppBuilder framework, and the ArcGIS API for JavaScript efficiency supported consumption of data and allowed creation of the application through multiple phases without required additional mapping software platforms and APIs. The Esri API could meet all the functionality requirements for the desired functionality through easy to create widgets through the Web AppBuilder. Custom code would not have to be written to actually create the widgets themselves. The Esri application code could also be customized easily to meet UI/UX requirements. The Esri API also allowed for the ability to deploy the application to the public without having to log in and the application be free to the user.

4.1.7. Code and File Customization Software

Adobe Dreamweaver and Photoshop were chosen as the software pieces to further customize code in the application and photo files of the application. Adobe Dreamweaver allowed for the local site to be set up to organize the files and how they would appear on the remote web server site. Dreamweaver also allowed for the application code to be edited and pushed to the web server. Firefox inspector tools were used to identify specific element code that needed to change in the application.

4.2. Data Sets, Sources, and Preparation

This section details the data that was used in the application and the processes for preparing each to be served into the web map in order to meet the required data layers. The data includes the following: preparation needs assistance requests, shelters, fault lines, liquefaction zones, landslide zones, hospitals, urgent care facilities, community senior centers, and nursing homes. Data in the application comes from several different sources, including federal, state, and local agencies. All data is loaded to the application in the form of REST services. Table 1 shows the data included the application and the source from which it comes from. Section 4.2.1 details the shelter data. Section 4.2.2 reviews the earthquake-related data. Section 4.2.3 discusses emergency service data. Section 4.2.4 discusses nursing homes and senior community center data.

Table 1. Data Sets and Data Sources

Data Set	Source	Format
Faults	LAHub	REST
Liquefaction Zones	CGS	REST
Landslide Zones	CGS	REST
Shelters	FEMA	REST
Wheel Chair Accessible Shelters	FEMA	REST
Nursing Homes	DHS	REST
Senior Centers	LAHub	REST
Hospitals	DHS	REST
Urgent Care Facilities	DHS	REST

4.2.1. Shelter Data

Data on shelters were sourced from the FEMA National Shelter System. The data layer contains shelter locations that are in the National Shelter System. The information for each location contains the place name, address, city, and other information, such if the shelter open or closed. The shelter data also has information concerning ADA compliance and wheelchair accessibility. The data was available through a REST service by way of a Feature Access service and a Web Mapping Service. The service proved to be unreliable early in the development process because of server maintenance issues. The data had to be exported, filtered, and rehosted. The shelters were queried to the Los Angeles area and then extracted to a file geodatabase. The shelters would be timestamped as of the day they pulled extracted to be used only for the prototype application for testing. The features were then shared to USC SSI's AGOL account to be used as feature access layers. The layers were broken into all shelters and wheelchair accessible shelters to notate the difference and make it easier to locate shelters that had wheelchair access.

4.2.2. Earthquake-Related Data

Data on fault lines, liquefaction zones, and landslide zones were added to the application. The fault line dataset was sourced from the LA Geohub AGOL organizational account which is owned and operated by the City of Los Angeles. The data was originally provided to them by the California Geological Survey. The service provided clear, simplified fault lines which fall in line with the principles of simplified symbols over use of complicated symbols. The fault line had a single symbol as opposed to other fault line layer services on AGOL. Other fault line data services such as the one from the USGS had the layers broken into multiple different types of faults. The LA Hub only had the fault line along with the name for the fault.

The liquefaction and landslide hazard datasets were sourced from ArcGIS servers produced by the California Geological Survey. The REST service links for each service provided polygon areas of hazard that allowed the ability to be individually added and symbolized to ensure that layers contrasted clearly within the map. The California Geological Survey is the authoritative source for these layers, which ensures data integrity, and using their services ensured that the data would be up to date in the application.

4.2.3. Emergency Service Layers

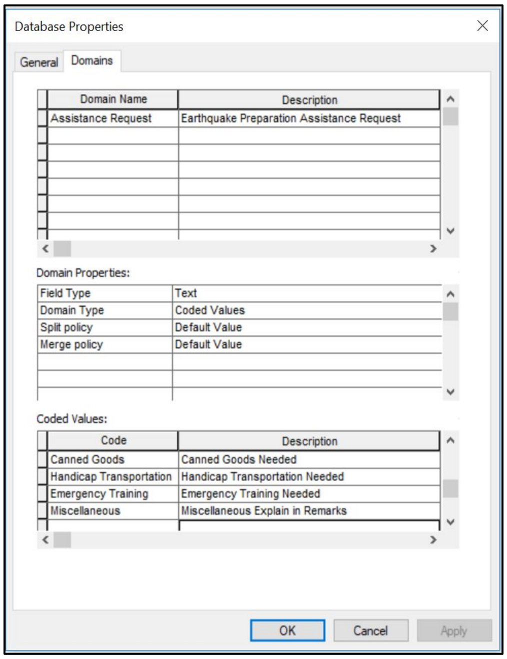
The emergency service locations were added as a REST service from a FEMA server that is comprised of the Department of Homeland Security Homeland Infrastructure Foundation-Level Data. The dataset is curated by the United States Department of Homeland Security and contains GIS data from multiple different parts of the infrastructure. The infrastructure data set is commonly used by government agencies during emergency situations because the dataset has locations of places that are emergency related such as hospitals, urgent care facilities, and police stations, etc. Only hospitals and urgent care facilities were chosen in order to simply the map layers to adhere to limiting the number of layers in the application for ease of use for older users.

4.2.4. Senior Reference Layers

Nursing homes and community senior centers were added to meet the requirement for the senior reference layers. The nursing homes and community seniors are both feature layers of reference for the older adult community. The senior reference layers are sourced from REST services online. The nursing home location layer was sourced from the FEMA server storing the infrastructure datasets, and the senior community senior centers were sourced from the LA Geohub AGOL organization which is run by the City of Los Angeles. The data is created and served out by partners of the City of Los Angeles. Both layers were added from reliable sources to ensure data integrity for emergency planning.

4.3. VGI Layer Preparation

To meet the requirement of allowing users to add assistance request points to the map, a new dataset had to be created for the data points to go in. First of all, the data schema had to be created that contained the type of attribute information that could be created, such as assistance request type and description fields. The data template and REST service were created by the developer for this project based on the requirements to meet the web-based data requirement and the requirement. The preparation needs assistance request points layer was created using the software ArcMap for ArcGIS. The types of requests were created as domain types and then added to the field of the assistance request points. Figure 4 shows the setting of the database property domains for the preparation needs assistance request points. This was set up to create an easy to pick from template of point types to choose from. Once the points were created, the data layer was saved and then shared as a web feature access service to the USC SSI's organizational account on arcgis.com. The web feature access service was then set to be editable by users so that the map feature layer could be edited in the map.



Domain Name	Description
Assistance Request	Earthquake Preparation Assistance Request

Domain Properties:

Field Type	Text
Domain Type	Coded Values
Split policy	Default Value
Merge policy	Default Value

Coded Values:

Code	Description
Canned Goods	Canned Goods Needed
Handicap Transportation	Handicap Transportation Needed
Emergency Training	Emergency Training Needed
Miscellaneous	Miscellaneous Explain in Remarks

Figure 4. Preparation Needs Assistance Request Point Domains

4.4. Customizing the Map Background

Map backgrounds in web maps are typically comprised of vector map tiles or raster imagery tiles added to give the map reference for the operational layers to be layered against. The application was designed and built using the Esri API and the Web AppBuilder. The Esri

Web AppBuilder offers a small variety of out-of-the-box map background layers. The out-of-the-box map backgrounds are tiled layers that bring detail based on the scale. The larger the scale, the more detail the map provides.

To meet all of the application map and layer design requirements, the application needed a background with a simplified map removing and combining some detail, high contrasting features, and larger, clear map layers and symbols. None of the out-of-the-box map backgrounds in Web AppBuilder met those needs. An example of an out-of-the-box Esri basemap can be seen in Figure 5. Therefore, the project development used a relatively new vector tile style editor that Esri provides to customize a map background.

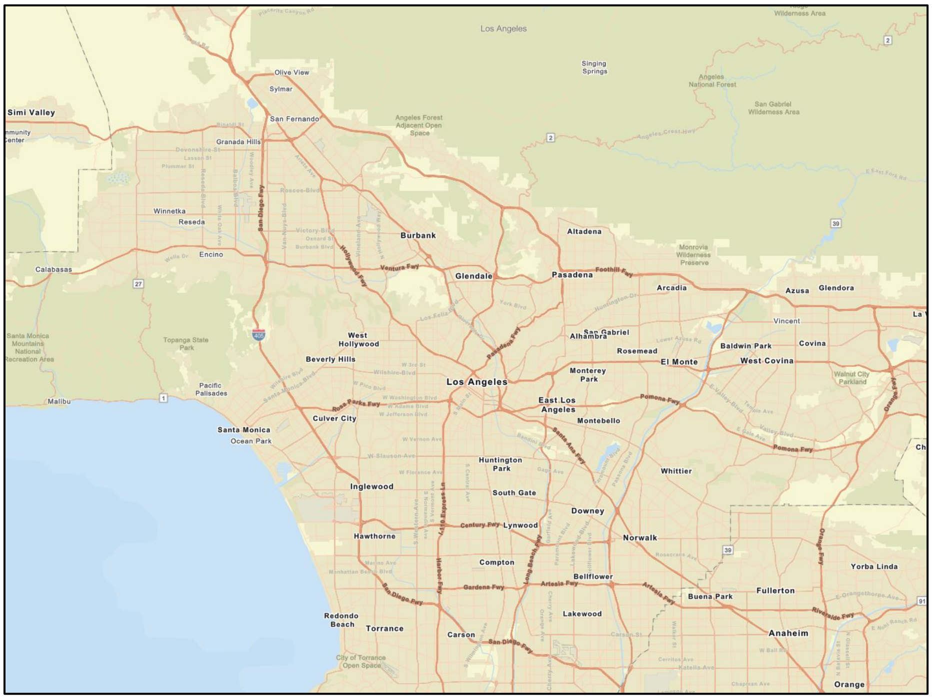
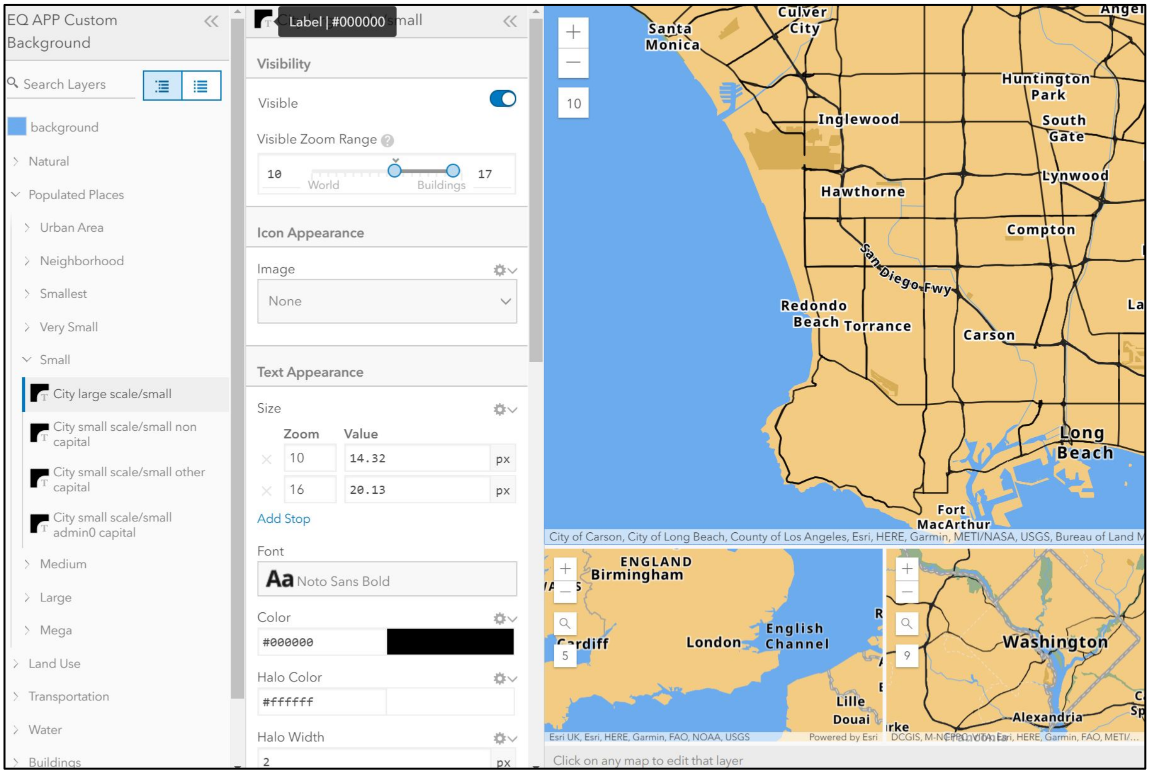


Figure 5. Screenshot of Non-Customized Esri Base Map

Using the vector tile style editor shown in Figure 6, a base map was chosen and edited to simplify and bring out a higher contrast. The map background colors were changed to tan, and the roads were changed to dark black so they would contrast well from the background. The roads were set to appear more detailed the more a user zoomed in user was. The scale level of the roads was set that the most detailed roads only turned on when zoomed in to the community level to make the map easier to see without all the roads cluttering the map when zoomed out. The labels were set to the highest contrast possible and increased in size to make the font larger. Fonts were also set to sans serif and bold as those fonts are easier to read online for older adult users (Johnson and Finn 2017). Water layers were all turned to the same color of blue, and some smaller bodies of water were omitted to simplify the map. Buildings were set to only appear at the 17th scale level to declutter the map at smaller scales. Only the largest of parks and forest areas were set to be displayed unless zoomed into the map, in order to simplify the default map extent map. Place names were only shown for larger cities, and they were shown with larger fonts and bold outlines.



EQ APP Custom Background

Search Layers

- background
- Natural
- Populated Places
  - Urban Area
  - Neighborhood
  - Smallest
  - Very Small
  - Small
    - City large scale/small
    - City small scale/small non capital
    - City small scale/small other capital
    - City small scale/small admin0 capital
  - Medium
  - Large
  - Mega
- Land Use
- Transportation
- Water
- Buildings

Label | #000000 mall

Visibility

Visible

Visible Zoom Range: 10 – 17 (World – Buildings)

Icon Appearance

Image: None

Text Appearance

Size

Zoom	Value
10	14.32 px
16	20.13 px

Add Stop

Font: Aa Noto Sans Bold

Color: #000000

Halo Color: #ffffff

Halo Width: 2 px

City of Carson, City of Long Beach, County of Los Angeles, Esri, HERE, Garmin, METI/NASA, USGS, Bureau of Land M

Esri UK, Esri, HERE, Garmin, FAO, NOAA, USGS

Powered by Esri

DCGIS, M-NCPPC, VITA, Esri, HERE, Garmin, FAO, METI/...

Click on any map to edit that layer

Figure 6. Tile Style Editor

The finished customized map background consists of the edited and customized features and label text (Figure 7). The map features a more common single base brown/tan color that makes features easier to see when overlaid on top of the base map. The base map features less detail at larger scale levels with larger labels with high contrast. The roads also display a simplified symbology, and many other background features were set to be not displayed. The roads were also symbolized to show more contrast against the background by choosing black and dark grey as opposed to light colors.

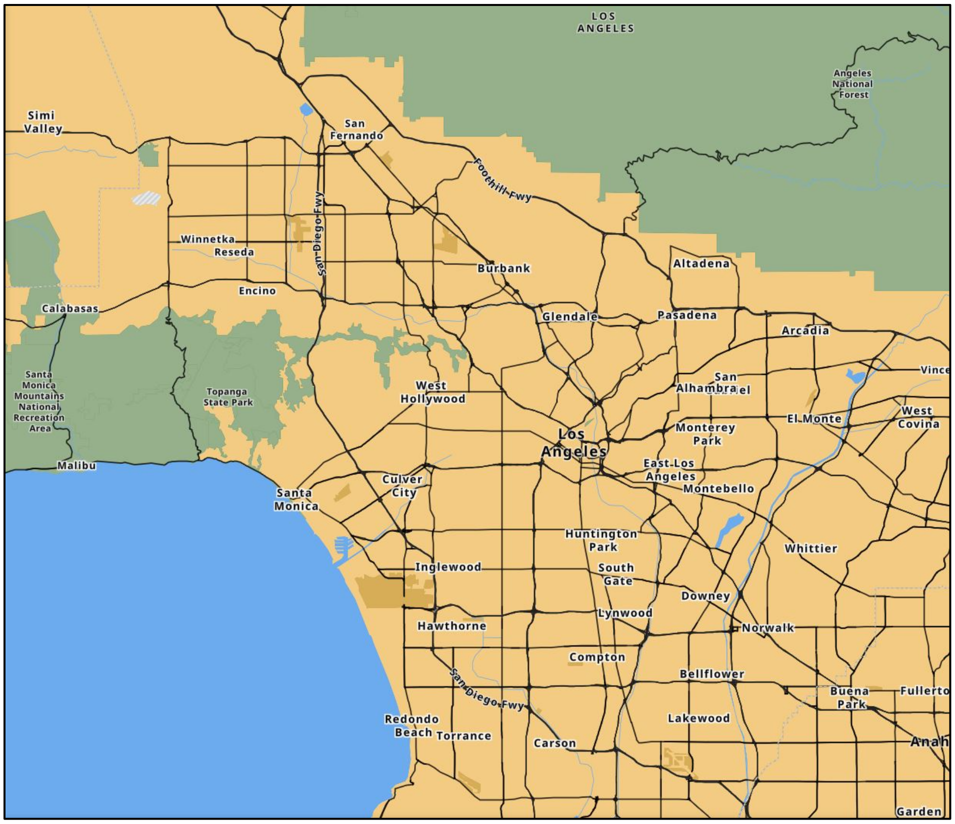


Figure 7. Screenshot of Customized Base Map

4.5. Map Creation

The next steps were to bring all the data layers together into a single map and customize the map. Section 4.5.1 discusses bring the map layers together in the mapping application. Section 4.5.2 describes applying symbolization. Section 4.5.3 discusses creating pop-ups for the map layers for identification.

4.5.1. Adding Layers to the AGOL Map

The map was opened on AGOL within the USC SSI organizational account to begin adding layers using the add layers button. Layers that were hosted within the developer's content on AGOL were added by doing a simple search for layer names. The other layers that are hosted on AGOL by other users were added by searching for layers in AGOL and clicking the add layer button. Layers that were not hosted on AGOL and were hosted on outside REST services were added using the search for web layer and copying in the URL to the individual REST services to add them to the map. The layers were ordered so that shelters would be on the top, the senior centers and nursing homes below that, the emergency services below that, the earthquake related layers beneath those, and the assistance request points just above the customize map background layers.

4.5.2. Symbology

After the map layers were added to the map, the symbology was set for the map layers. The symbology of the layers chosen was based on the design requirements for mapping for older adults. Layers were simplified to make the map clearer and set to be scale dependent so that they would only turn on when the map was zoomed in.

4.5.2.1. Shelter Symbology

Shelter layers were symbolized with commonly recognized shelter symbols in high contrast against the background map. Wheelchair accessible shelters were symbolized with FEMA's symbology, which features a green square with a wheelchair symbol (Figure 8). This is a common symbol for wheelchair accessible places. All other shelters were shown with the dark grey and white shelter symbol from the Esri template for shelters. Since this was the symbology template used by Esri, it is commonly known shelter symbology and should be easily recognizable. This symbol choice provided high black and white contrast and would not blend with the green wheelchair accessible shelters.

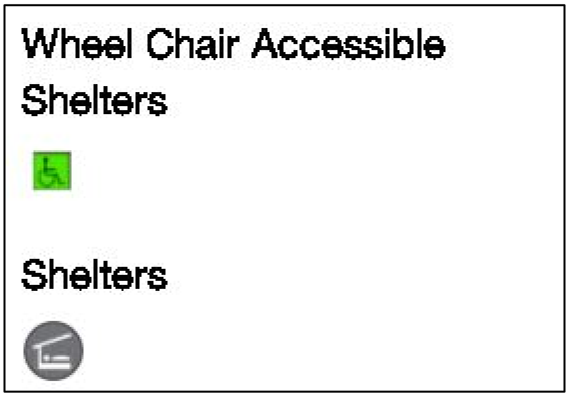


Figure 8. Shelter Symbology

4.5.2.2. Emergency Service Symbology

Emergency service features were symbolized with commonly used symbols for emergency services so that the layers would be recognizable (Figure 9). The points were set to be at a high contrast with a map background and with other symbols. The point symbology was set to 40px sizing, which is larger than the normal default setting for the symbols chosen. Hospitals were symbolized with a black H in a white square box, which is a common symbol for hospitals. Urgent care facilities were symbolized with the common red symbol for emergency medical care.

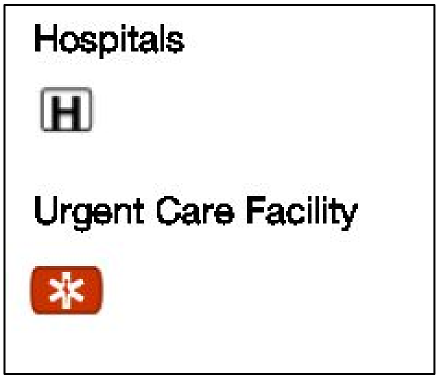


Figure 9. Emergency Service Symbols

4.5.2.3. Earthquake Hazard Layers

Earthquake hazards were symbolized to identify areas of hazards so they could easily be distinguished and understandable. The earthquake faults were symbolized with thick red lines. In a lot of the datasets found available, the earthquake faults are broken into many pieces and categories for the type of fault; for simplification, faults were shown as one consistent line symbol that would pop against the map background (Figure 10).

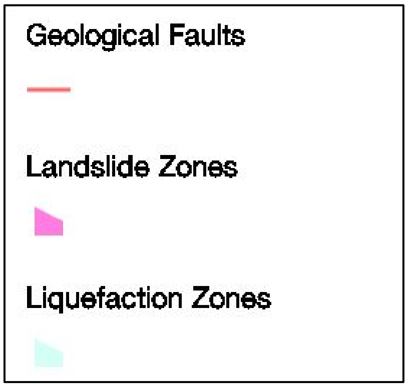


Figure 10. Earthquake Hazard Symbols

The liquefaction layer was given a light blue color that shows up well against the tan map background and does not blend with other layers. The landslide hazard zones were symbolized with a light pink color as to contrast well with the other layers in the map. Both the landslides layer and the liquefaction layer were set to medium transparency so that the map background could be seen through polygon symbols. Below shows the symbology used for the earthquake-related hazards. Figure 11 shows the map with the liquefaction, landslide, and fault layers turned on.

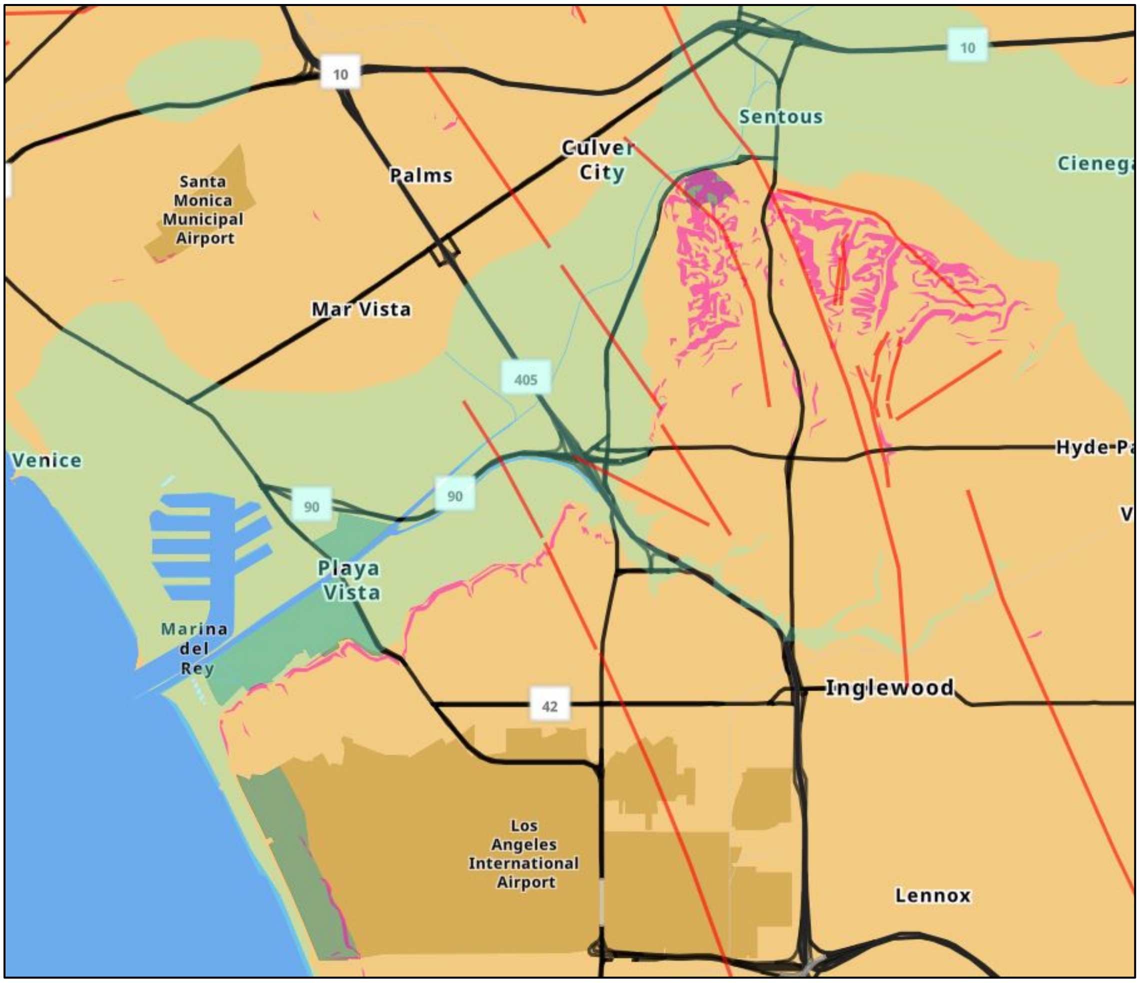


Figure 11. Screenshot of Earthquake Hazards Map

4.5.2.4. Senior Reference Layers Symbology

As with other layers, the senior reference layers symbology was chosen to contrast with other layers and the background (Figure 12). Community senior centers were represented as point symbols with a building and flag representing a meeting place as senior centers are locations that some older adults will meet for activities and events. The colors in black and white show up against the tan map background and do not blend with other layers. The nursing homes layer was chosen based on familiar symbology with the word home. The house symbol from Esri templates was chosen for this layer.

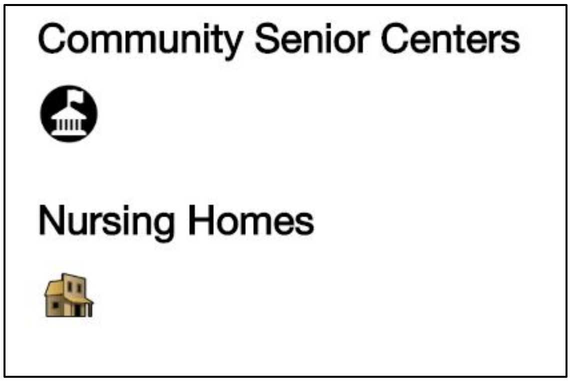
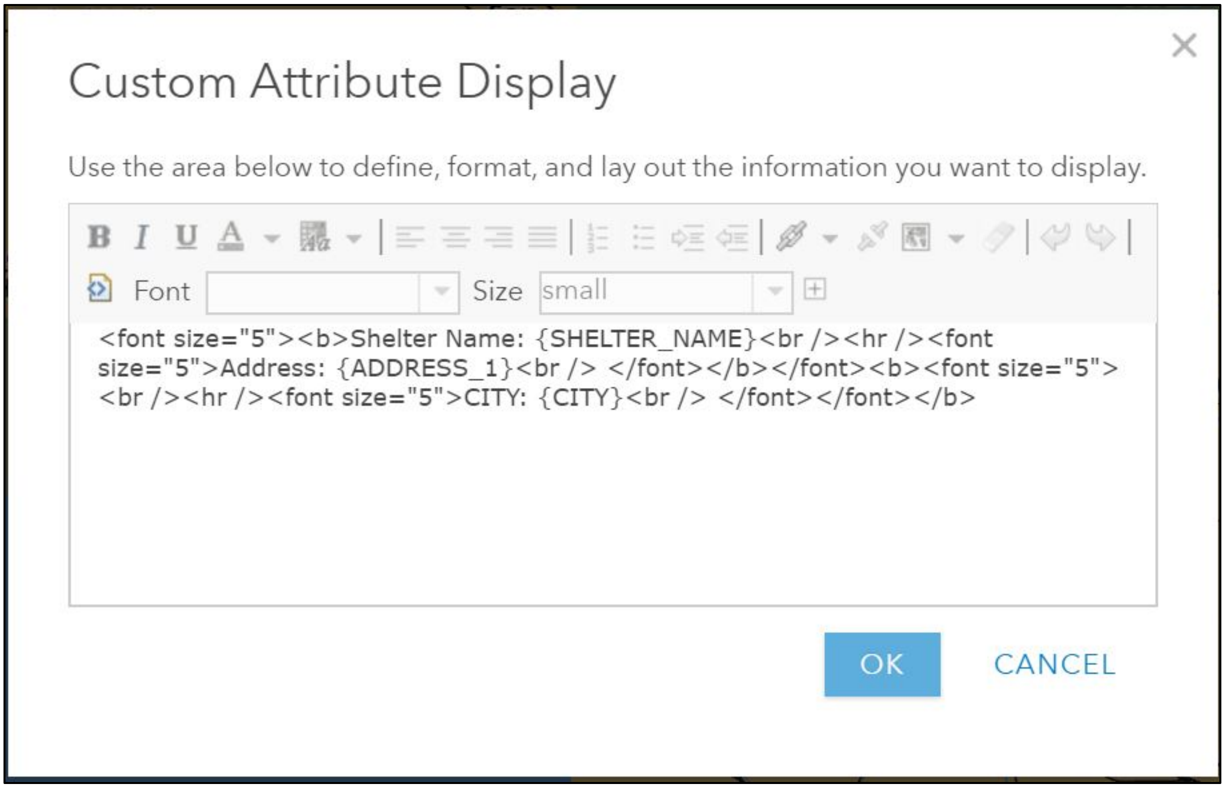


Figure 12. Senior Reference Layer Symbols

4.5.3. Setting Layer Pop-Ups

A key functionality requirement for the application for users to be able to identify features of the map. To meet this desired functionality, pop-up information boxes were added to the map layers. Pop-ups were set to provide information on what the map layer is, and the specific feature clicked, such as a place name, address, phone number, or other information.

The typical pop-up within Esri AGOL display either one attribute, a list of attributes in table format, or a customized format. In order to show different attributes and to be able to customize the pop-up, the custom pop-up was chosen. The HTML customizations provide options for font choice and size to make the information appear larger than the default popup. Pop-ups for the earthquake hazard layers were set to show only the name of the layer. Pop-ups for the reference layers and the emergency service layers were set to show the place name, address, and phone number. Pop-ups for the shelters were set to show the shelter name, address, and city (Figure 13).



Custom Attribute Display

Use the area below to define, format, and lay out the information you want to display.

```
<font size="5"><b>Shelter Name: {SHELTER_NAME}<br /><hr /><font
size="5">Address: {ADDRESS_1}<br /> </font></b></font><b><font size="5">
<br /><hr /><font size="5">CITY: {CITY}<br /> </font></font></b>
```

Figure 13. Shelter Pop-Up Code

4.6. Base Application Creation in Web AppBuilder

The base application was created in Web AppBuilder in two processes. Section 4.8.1.1 will discuss the process of setting the theme, color, and title. Section 4.8.1.2 will discuss the process of selecting and configuring the base widgets.

4.6.1.1. Selecting Theme, Color, and Name

The first step in the process of creating the base web mapping application was to choose the application theme from Esri's set of out-of-the-box themes (Figure 14). The dart-controller theme was chosen because all of the tools and the title of the application all appear in a container at the bottom of the application. Using the dart controller theme would be easier to use as it makes navigating the functions easier in order to meet the easier application navigation requirement. Many of the other themes had buttons all over the interface rather than having them all along the bottom. The dart theme also has individual panels that open as windows when the widget buttons are clicked on. The panel windows can be individually closed also when the user is finished. Research on older adult applications suggested that keeping the buttons together would make using the application easier for older adults. Other themes the widget buttons and titles all over in different places and different tabs.

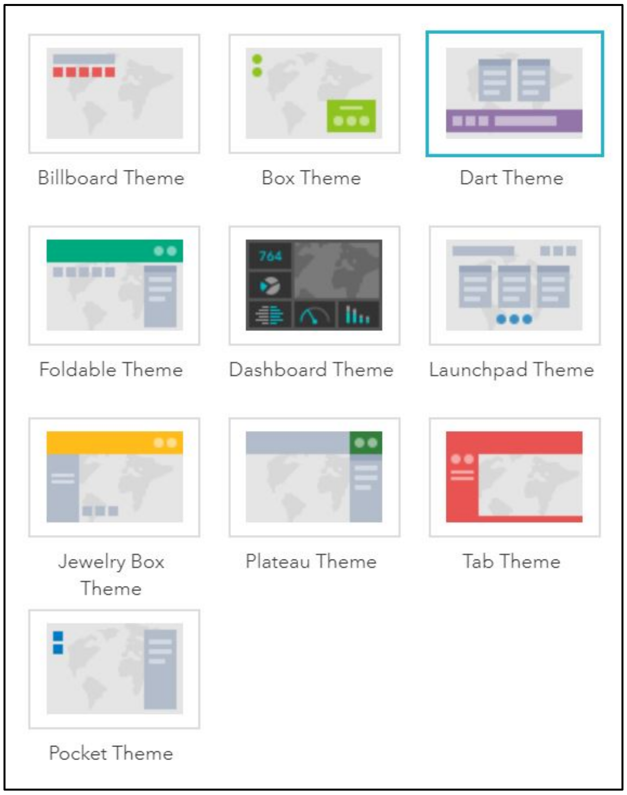


Figure 14. Dart Theme Layout

The color of the theme was also chosen as red because red is often associated with emergency application apps and draws attention (Figure 15). The red color also contrasts well with other elements that might be on the device screen. The color theme controls the color of the title bar, panel bars, pop-up box wrappers. The name was initially set to the EQ Preparation Application, but it was renamed later to EQ Prep App to be shorter due to sizing constraints on smaller screens during a later step.

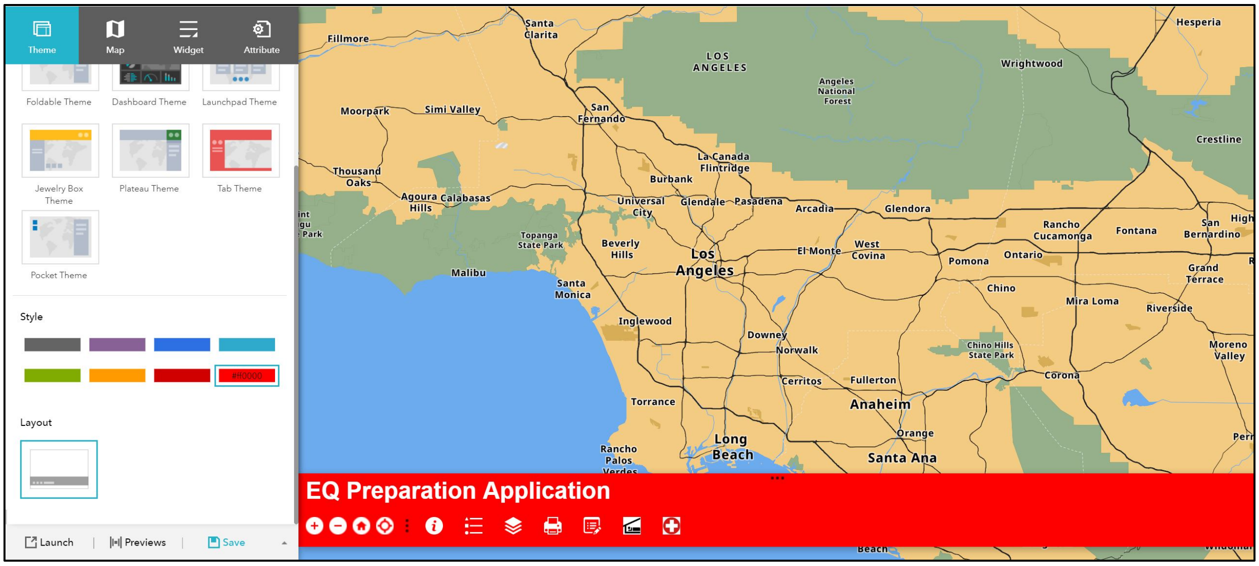


Figure 15. Web AppBuilder Theme and Style

4.6.1.2. Application Widgets

The next step in the base application was to choose and configure the widgets. Using Widget Wizard in Web AppBuilder (Figure 16), the first group of widgets that were added to the app to the left of the ellipses included the Zoom Slider, Home, Zoom to Location widgets in order to meet the requirements to be able to zoom in and out and find location. The second group of widgets that were added to the app to the right of the ellipses included the About, Legend, Operational Layers, Print, Edit, and the Nearest Widgets. The nearest widget was added twice to be able to find nearest shelters and nearest emergency services. These widgets were added to meet the requirements of printing, turning on and off layers, adding points, and finding the nearest emergency services. Adding the Legend widget helped with meeting the requirement for identifying features, but the pop-ups configured in 4.5.3 also helped to meet that requirement.

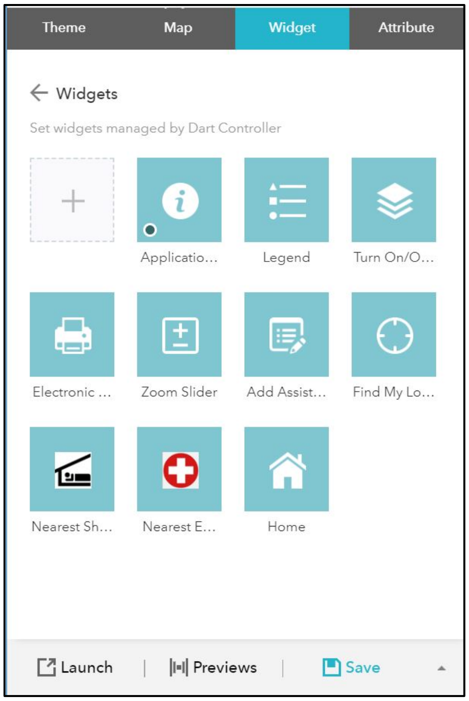
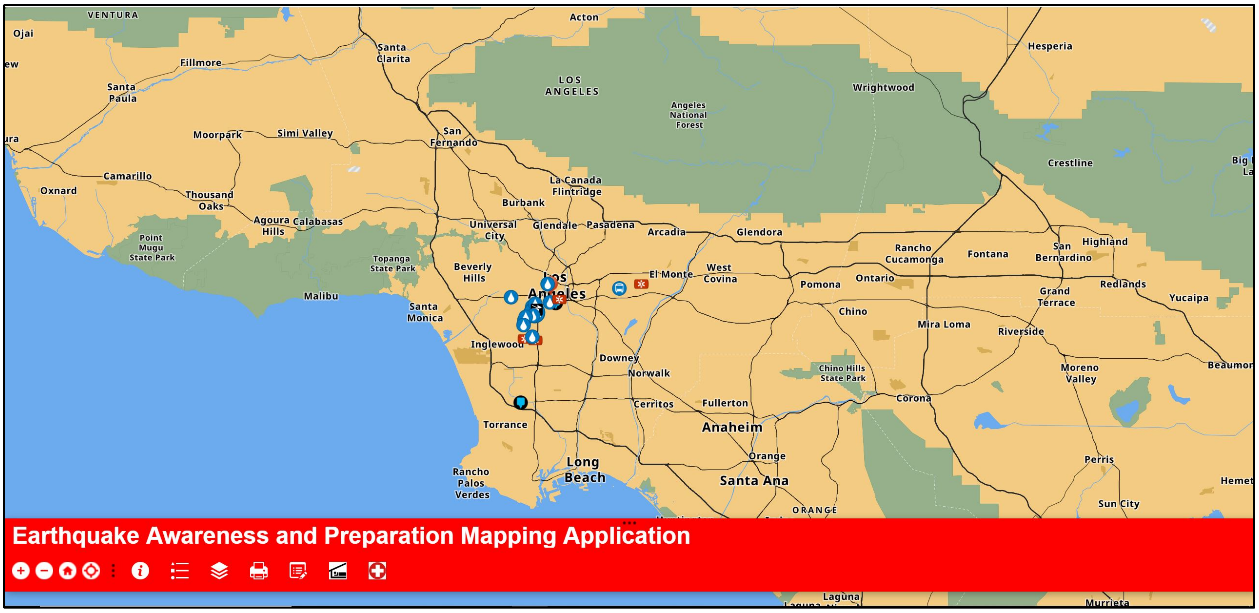


Figure 16. Widget Chooser Panel

The Zoom Slider widget was added to be able to allow zoom in and zoom out functionality to the map. The Home widget was also added to allow the user the functionality to back to the default location of the map. The map default location was set to show the entire Los Angeles metro area. The Find My Location widget was added to give the user the ability to zoom to their location. The widget asks the web browser for permission to use the device's location. When the widget is turned on, the map will zoom to the area and show a blue location marker on the map.

The Application Information widget was added to display information about the application, such as a demo link, how to document link, and disclaimer information. The About widget was set to be turned on when the application opens so that the user would see the links and disclaimers at the outset. The Legend widget was added to the application so that the user could identify map symbology and associated map layers. The operational layers widget was added so that users would have the ability to make the map as simplified or detailed as they would like with the ability to turn on and off layers. The Print widget was added so that the user could print out a view of the map that could be later used away from the application. The edit widget was added to allow the user to add preparation needs assistance request points. The Nearest Emergency Services widget was added and configured to let the user find the nearest hospitals and urgent care facilities. Its widget button was given a customized icon that represented emergency services with a red cross and white outline. The Nearest Shelters widget was added and configured to allow the user to find the nearest shelters and wheelchair accessible shelters. The widget button was given a customized icon to represent shelters. Both of the nearest widgets were both set to a default 1 mile and to a maximum 5-mile search radius. Once all the widgets were added, the base application (Figure 17) was complete and ready for further customization outside of AGOL Web AppBuilder.



Earthquake Awareness and Preparation Mapping Application

Figure 17. AGOL Web AppBuilder Base Application

Chapter 5 Application Customization

This chapter discussed the customization of the base application that was created in AGOL Web AppBuilder. Section 5.1 discusses the steps taken to prepare for the customization of the application by setting up and using Web AppBuilder Developer Edition and setting up the code editing software that was used to edit the code and push the application to the hosting web server. Section 5.2 describes customization of the application code.

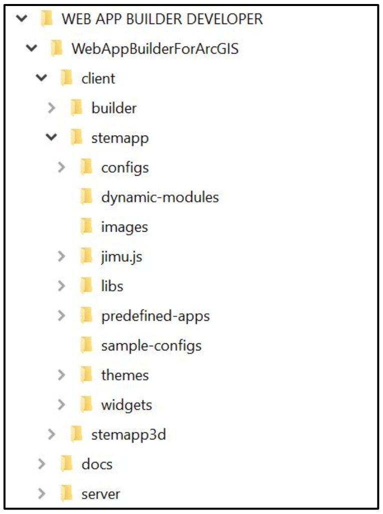
5.1. Preparing for Customization

The next step in the process was to further customize the out of the box application developed using AGOL Web AppBuilder. As the application stood, design requirements were not all met. The next steps involved getting into the application code files and making the necessary customization to the application code in order to get the desired results. In order to do that, the application had to be imported into Web AppBuilder Developer Edition on the local machine and then exported from Web AppBuilder Developer Edition to a different location on the local machine to make the necessary changes to application code. Sections 5.2.1 discusses setting up Web AppBuilder Developer Edition. Section 5.6.2.2 details using Web AppBuilder Developer edition in order to import the application from AGOL and then exporting the application from there and why the Web AppBuilder Developer Edition was used for this process Section 5.6.2.2 details application folder structure after the application was exported from Web AppBuilder Developer Edition. Section 5.6.2.3 discusses setting up the Adobe Dreamweaver software and setting up the application to be edited by Adobe Dreamweaver.

5.1.1.1. Setting up Web AppBuilder Developer Edition

The next step in the application process was to use Web AppBuilder Developer Edition to customize the application beyond what is possible in AGOL. The Web AppBuilder Developer Edition program was downloaded to the local machine with a developer license. Using the startup batch file within the Web AppBuilder Developer folder, the developer started the program. The developer edition was then registered with the developer's AGOL account by giving an App ID and the Web AppBuilder developer machine's address which was the local computer name where the Web AppBuilder Developer was installed. After registration, the Web AppBuilder Developer Edition was ready to be used to import the base application that had been built in Web AppBuilder on AGOL.

The fold structure shown in Figure 18 shows all of the top folders directly below the Web AppBuilder Developer folder. The folder includes the client folder, the builder folder, stemapp folder, the stemapp3d folder, the docs folder, and the server folder. The code files that affect 2d applications imported in to Web AppBuilder Developer Edition are stored in the stemapp directory. The themes files that can be applied to an application are located in the themes directory and specialized themes can be added there. The widgets folder contains files for the make-up of the available widgets. New customized widgets can be added here.

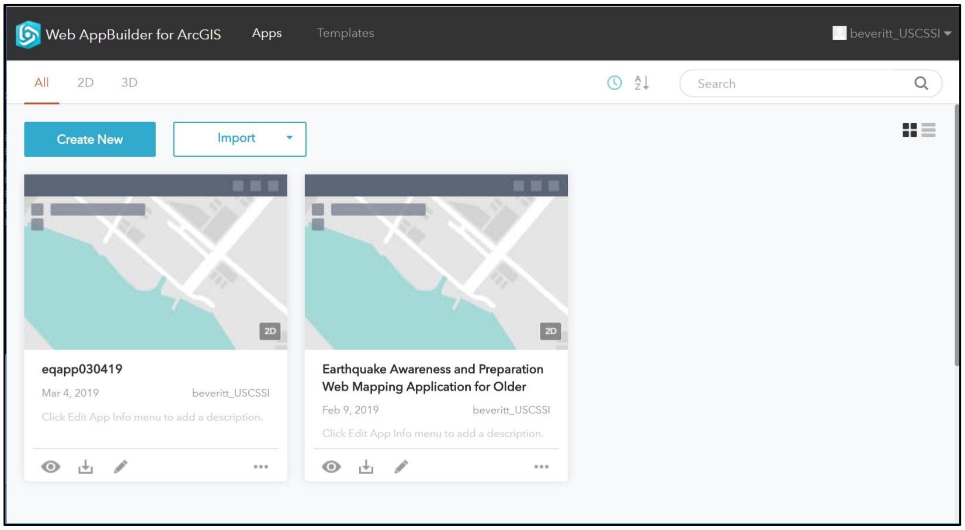


```
WEB APP BUILDER DEVELOPER
  WebAppBuilderForArcGIS
    client
      builder
      stemapp
        configs
        dynamic-modules
        images
        jimu.js
        libs
        predefined-apps
        sample-configs
        themes
        widgets
      stemapp3d
    docs
    server
```

Figure 18. Web AppBuilder Developer Folder Structure

5.1.1.2. Using Web AppBuilder Developer Edition

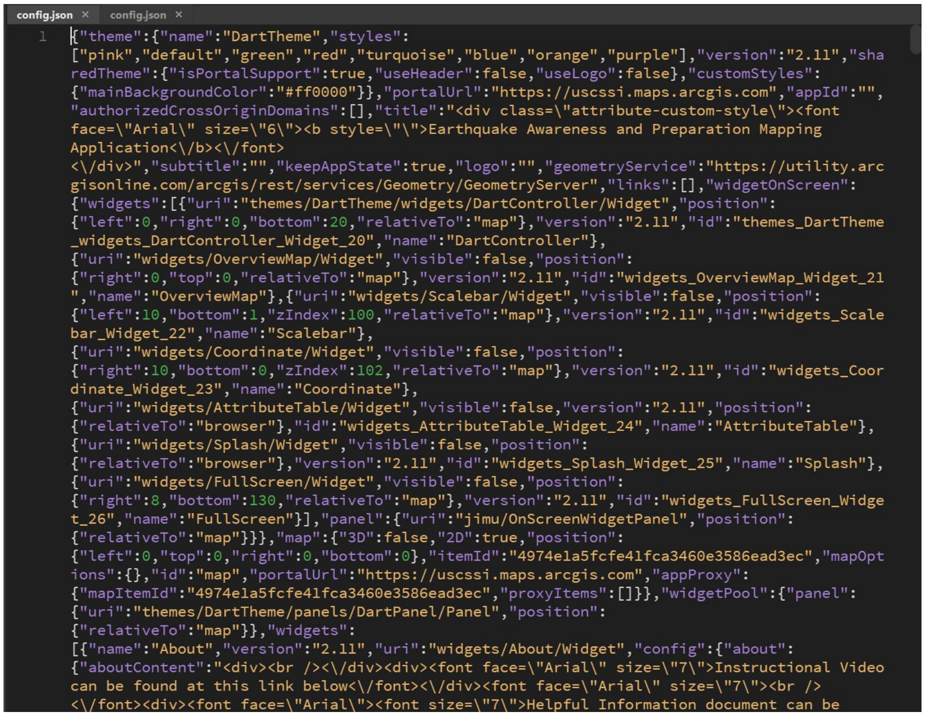
The process for using Web AppBuilder Developer for this project was to import the application and restructure the application files to be edited using a code editing software. The EQ Preparation Application developed in AGOL was imported into Web AppBuilder Developer Edition from AGOL using the Web AppBuilder that can be seen in Figure 19 with the application imported. The Web AppBuilder Developer edition takes the applications from AGOL and updates the folders and code to be recognized in code editing software. If an application is downloaded directly from AGOL, the application files are not recognized correctly, and the code is not organized, as shown in Figure 20. Web AppBuilder Developer takes those files and organizes the structure of the code so that the code editing software could recognize the files once the application was exported from Web AppBuilder Developer. The results of what the code looked like after using Web AppBuilder Developer Edition can be seen in Figure 21. Web AppBuilder Developer wouldn’t have been used otherwise as the Web AppBuilder Developer edition allows changes to be made only to code for themes and other common file code to be applied to the application or other applications once imported. The developer wanted to be able to make changes to the code of the application itself and not make changes to code in Web AppBuilder Developer Edition that is only for the codes that are in Web AppBuilder Developer that can be applied to any application. Make changes to the code in Web AppBuilder Developer wouldn't change the code to the application itself. If the developer did that, then the base code would be changed and applied to any application in Web AppBuilder Developer.



eqapp030419
Mar 4, 2019 beveritt_USCSSI
Click Edit App Info menu to add a description.

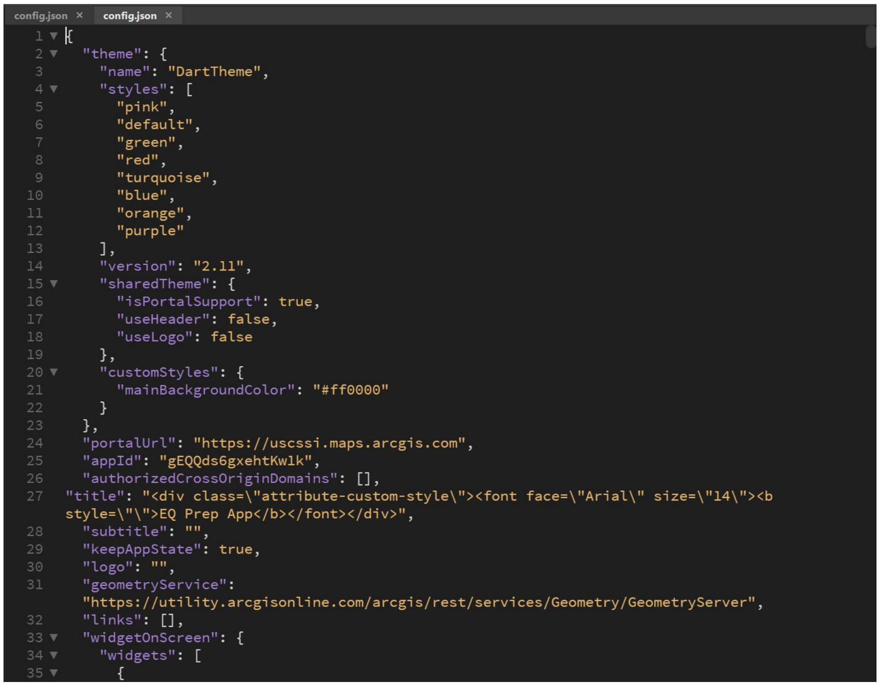
Earthquake Awareness and Preparation Web Mapping Application for Older
Feb 9, 2019 beveritt_USCSSI
Click Edit App Info menu to add a description.

Figure 19. Web AppBuilder Developer Edition Window



```
{"theme":{"name":"DartTheme","styles":
["pink","default","green","red","turquoise","blue","orange","purple"],"version":"2.11","sha
redTheme":{"isPortalSupport":true,"useHeader":false,"useLogo":false},"customStyles":
{"mainBackgroundColor":"#ff0000"}},"portalUrl":"https://uscssi.maps.arcgis.com","appId":"",
"authorizedCrossOriginDomains":[],"title":"<div class=\"attribute-custom-style\"><font
face=\"Arial\" size=\"6\"><b style=\"\">Earthquake Awareness and Preparation Mapping
Application<\/b><\/font>
<\/div>","subtitle":"","keepAppState":true,"logo":"","geometryService":"https://utility.arc
gisonline.com/arcgis/rest/services/Geometry/GeometryServer","links":[],"widgetOnScreen":
{"widgets":[{"uri":"themes/DartTheme/widgets/DartController/Widget","position":
{"left":0,"right":0,"bottom":20,"relativeTo":"map"},"version":"2.11","id":"themes_DartTheme
_widgets_DartController_Widget_20","name":"DartController"},
{"uri":"widgets/OverviewMap/Widget","visible":false,"position":
{"right":0,"top":0,"relativeTo":"map"},"version":"2.11","id":"widgets_OverviewMap_Widget_21
","name":"OverviewMap"},{"uri":"widgets/Scalebar/Widget","visible":false,"position":
{"left":10,"bottom":1,"zIndex":100,"relativeTo":"map"},"version":"2.11","id":"widgets_Scale
bar_Widget_22","name":"Scalebar"},
{"uri":"widgets/Coordinate/Widget","visible":false,"position":
{"right":10,"bottom":0,"zIndex":102,"relativeTo":"map"},"version":"2.11","id":"widgets_Coor
dinate_Widget_23","name":"Coordinate"},
{"uri":"widgets/AttributeTable/Widget","visible":false,"version":"2.11","position":
{"relativeTo":"browser"},"id":"widgets_AttributeTable_Widget_24","name":"AttributeTable"},
{"uri":"widgets/Splash/Widget","visible":false,"position":
{"relativeTo":"browser"},"version":"2.11","id":"widgets_Splash_Widget_25","name":"Splash"},
{"uri":"widgets/FullScreen/Widget","visible":false,"position":
{"right":8,"bottom":130,"relativeTo":"map"},"version":"2.11","id":"widgets_FullScreen_Widge
t_26","name":"FullScreen"}],"panel":{"uri":"jimu/OnScreenWidgetPanel","position":
{"relativeTo":"map"}}},"map":{"3D":false,"2D":true,"position":
{"left":0,"top":0,"right":0,"bottom":0},"itemId":"4974e1a5fcfe41fca3460e3586ead3ec","mapOpt
ions":{},"id":"map","portalUrl":"https://uscssi.maps.arcgis.com","appProxy":
{"mapItemId":"4974e1a5fcfe41fca3460e3586ead3ec","proxyItems":[]}},"widgetPool":{"panel":
{"uri":"themes/DartTheme/panels/DartPanel/Panel","position":
{"relativeTo":"map"}},"widgets":
[{"name":"About","version":"2.11","uri":"widgets/About/Widget","config":{"about":
{"aboutContent":"<div><br /><\/div><div><font face=\"Arial\" size=\"7\">Instructional Video
can be found at this link below<\/font><\/div><font face=\"Arial\" size=\"7\"><br />
<\/font><div><font face=\"Arial\"><font size=\"7\">Helpful Information document can be
```

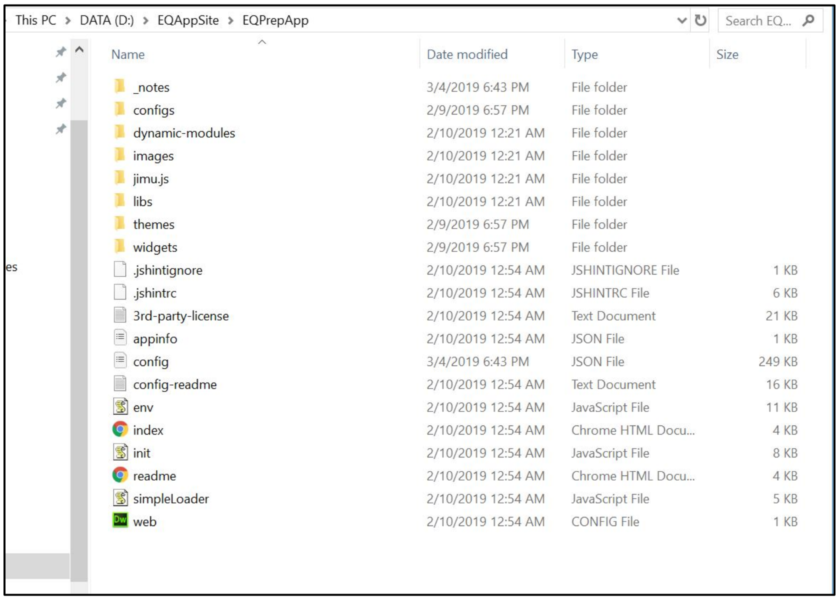
Figure 20. Code Downloaded Directly from AGOL to Local Computer



```
{
  "theme": {
    "name": "DartTheme",
    "styles": [
      "pink",
      "default",
      "green",
      "red",
      "turquoise",
      "blue",
      "orange",
      "purple"
    ],
    "version": "2.11",
    "sharedTheme": {
      "isPortalSupport": true,
      "useHeader": false,
      "useLogo": false
    },
    "customStyles": {
      "mainBackgroundColor": "#ff0000"
    }
  },
  "portalUrl": "https://uscssi.maps.arcgis.com",
  "appId": "gEQQds6gxehtKwlk",
  "authorizedCrossOriginDomains": [],
"title": "<div class=\"attribute-custom-style\"><font face=\"Arial\" size=\"14\"><b
style=\"\">EQ Prep App</b></font></div>",
  "subtitle": "",
  "keepAppState": true,
  "logo": "",
  "geometryService":
  "https://utility.arcgisonline.com/arcgis/rest/services/Geometry/GeometryServer",
  "links": [],
  "widgetOnScreen": {
    "widgets": [
      {
```

Figure 21. Code Downloaded to Local Computer Via Web AppBuilder Developer

Once the application was imported and restructured by Web AppBuilder Developer, it was then exported using the exporting application tool in Web AppBuilder Developer edition to a zipped folder on the local computer that could then be unzipped into separate application folder (Figure 22) located on the local machine that can then be edited with Adobe Dreamweaver and pushed to a web server. Section 4.6.2.3 gives a description of the unzipped application folder where the files to edited for customization were located.

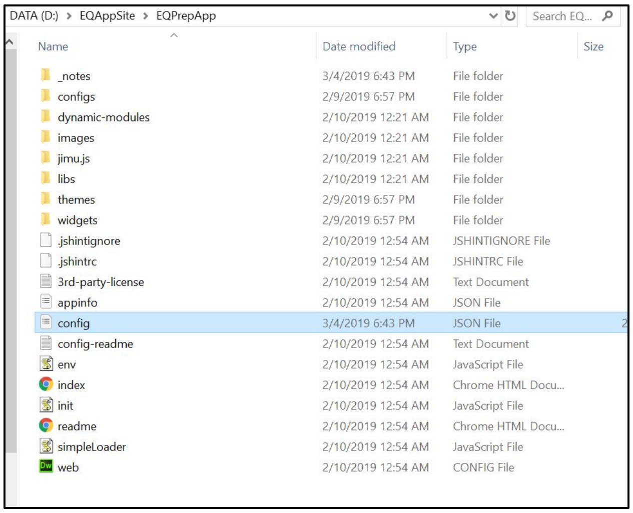

This PC > DATA (D:) > EQAppSite > EQPrepApp

Name	Date modified	Type	Size
_notes	3/4/2019 6:43 PM	File folder	
configs	2/9/2019 6:57 PM	File folder	
dynamic-modules	2/10/2019 12:21 AM	File folder	
images	2/10/2019 12:21 AM	File folder	
jimu.js	2/10/2019 12:21 AM	File folder	
libs	2/10/2019 12:21 AM	File folder	
themes	2/9/2019 6:57 PM	File folder	
widgets	2/9/2019 6:57 PM	File folder	
.jshintignore	2/10/2019 12:54 AM	JSHINTIGNORE File	1 KB
.jshintrc	2/10/2019 12:54 AM	JSHINTRC File	6 KB
3rd-party-license	2/10/2019 12:54 AM	Text Document	21 KB
appinfo	2/10/2019 12:54 AM	JSON File	1 KB
config	3/4/2019 6:43 PM	JSON File	249 KB
config-readme	2/10/2019 12:54 AM	Text Document	16 KB
env	2/10/2019 12:54 AM	JavaScript File	11 KB
index	2/10/2019 12:54 AM	Chrome HTML Docu...	4 KB
init	2/10/2019 12:54 AM	JavaScript File	8 KB
readme	2/10/2019 12:54 AM	Chrome HTML Docu...	4 KB
simpleLoader	2/10/2019 12:54 AM	JavaScript File	5 KB
web	2/10/2019 12:54 AM	CONFIG File	1 KB

Figure 22. Unzipped Folder Structure

5.1.1.3. Application Folder Structure

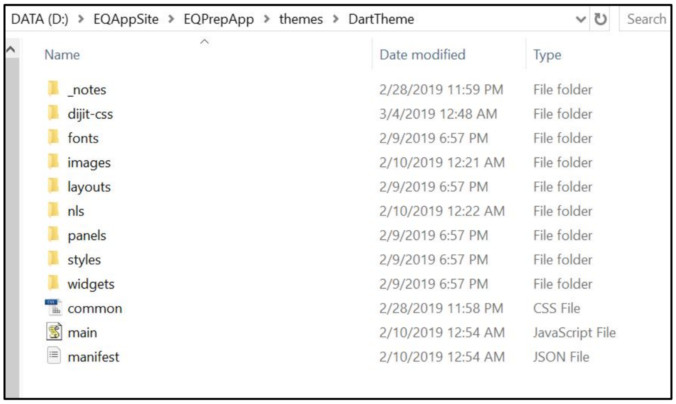
In the unzipped application folder shown previously in Figure 23, edits had to be made to CSS, HTML, JSON, and JavaScript files in order for the application to look and interact as desired. The structure was set up as the EQAppSite as the top folder name which would become the site name. The application was housed under the EQAppSite folder. The EQ Prep App folder contained the notes, configs, dynamic modules, images, jimu.js, libs, themes, and widgets folders as seen in the figure. Changes had to be made to files in the themes folder, widgets folder, and the jimu.js folder. The themes folder contained the files related to the theme of the application, such as styling, HTML codes, and JavaScript files that make the theme pieces work. The widgets folder contained the files for the different pieces of the application widgets such as the HTML, styling, and JavaScript files. Jimu.js is a class of JavaScript files and CSS files related to the Esri Web GIS API. The EQ Prep App Folder also contained the main config JSON file (EQAppSite\EQPrepApp\config.json) that had to be edited, as shown in Figure 23. The main config file contained much of the code that controls the application content.


DATA (D:) > EQAppSite > EQPrepApp

Name	Date modified	Type	Size
_notes	3/4/2019 6:43 PM	File folder	
configs	2/9/2019 6:57 PM	File folder	
dynamic-modules	2/10/2019 12:21 AM	File folder	
images	2/10/2019 12:21 AM	File folder	
jimu.js	2/10/2019 12:21 AM	File folder	
libs	2/10/2019 12:21 AM	File folder	
themes	2/9/2019 6:57 PM	File folder	
widgets	2/9/2019 6:57 PM	File folder	
.jshintignore	2/10/2019 12:54 AM	JSHINTIGNORE File	
.jshintrc	2/10/2019 12:54 AM	JSHINTRC File	
3rd-party-license	2/10/2019 12:54 AM	Text Document	
appinfo	2/10/2019 12:54 AM	JSON File	
config	3/4/2019 6:43 PM	JSON File	2
config-readme	2/10/2019 12:54 AM	Text Document	
env	2/10/2019 12:54 AM	JavaScript File	
index	2/10/2019 12:54 AM	Chrome HTML Docu...	
init	2/10/2019 12:54 AM	JavaScript File	
readme	2/10/2019 12:54 AM	Chrome HTML Docu...	
simpleLoader	2/10/2019 12:54 AM	JavaScript File	
web	2/10/2019 12:54 AM	CONFIG File	

Figure 23. Application Folder Structure

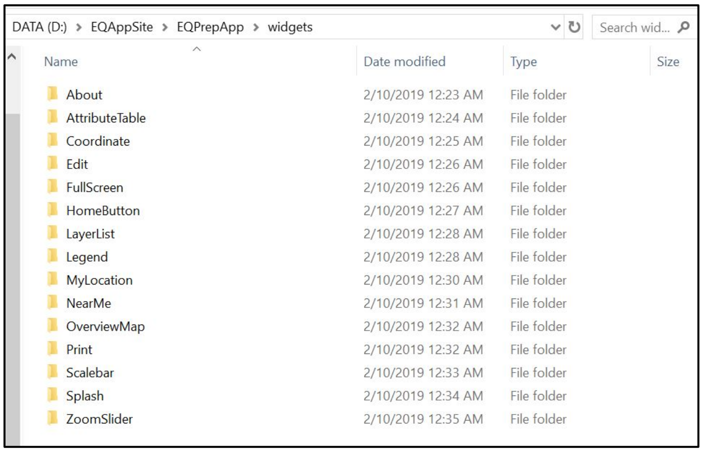
The themes folder contained the files that make up the application theme. Since the Dart theme was chosen, only the Dart theme files were present. The Dart theme folder (Figure 24) contained folders for notes, dijit CSS, fonts, images, layouts, nls, panels, styles, and widgets.


DATA (D:) > EQAppSite > EQPrepApp > themes > DartTheme

Name	Date modified	Type
_notes	2/28/2019 11:59 PM	File folder
dijit-css	3/4/2019 12:48 AM	File folder
fonts	2/9/2019 6:57 PM	File folder
images	2/10/2019 12:21 AM	File folder
layouts	2/9/2019 6:57 PM	File folder
nls	2/10/2019 12:22 AM	File folder
panels	2/9/2019 6:57 PM	File folder
styles	2/9/2019 6:57 PM	File folder
widgets	2/9/2019 6:57 PM	File folder
common	2/28/2019 11:58 PM	CSS File
main	2/10/2019 12:54 AM	JavaScript File
manifest	2/10/2019 12:54 AM	JSON File

Figure 24. Theme Folder

The widgets folder underneath the main application folder contained the subfolders for each widget included in the application (Figure 25). Each widget folder contained style.css files that contributed to the appearance of the application that needed to be customized.



DATA (D:) > EQAppSite > EQPrepApp > widgets

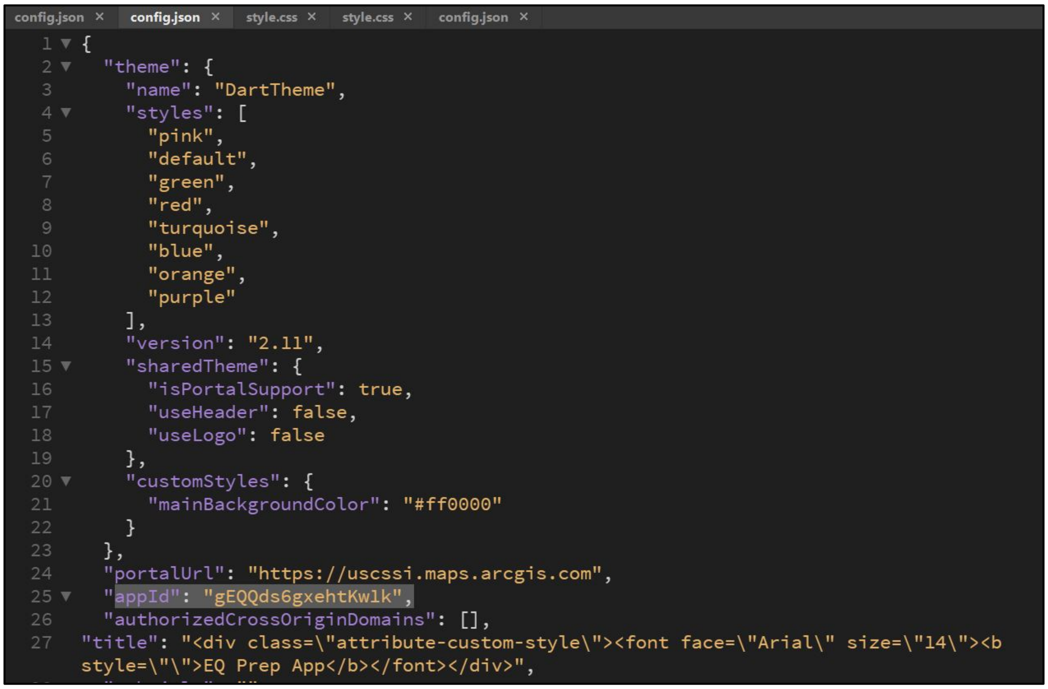
Name	Date modified	Type	Size
About	2/10/2019 12:23 AM	File folder	
AttributeTable	2/10/2019 12:24 AM	File folder	
Coordinate	2/10/2019 12:25 AM	File folder	
Edit	2/10/2019 12:26 AM	File folder	
FullScreen	2/10/2019 12:26 AM	File folder	
HomeButton	2/10/2019 12:27 AM	File folder	
LayerList	2/10/2019 12:28 AM	File folder	
Legend	2/10/2019 12:28 AM	File folder	
MyLocation	2/10/2019 12:30 AM	File folder	
NearMe	2/10/2019 12:31 AM	File folder	
OverviewMap	2/10/2019 12:32 AM	File folder	
Print	2/10/2019 12:32 AM	File folder	
Scalebar	2/10/2019 12:33 AM	File folder	
Splash	2/10/2019 12:34 AM	File folder	
ZoomSlider	2/10/2019 12:35 AM	File folder	

Figure 25. Widget Folder

5.1.1.4. Code Editing Software and Method

Adobe Dreamweaver was the code editing program used for this project. Adobe Dreamweaver was chosen as it can be used to edit CSS, HTML, JSON, and JavaScript files and push them to the web server. Since the application was local to the computer before pushing to the site, changes could not be seen after editing the code. Because of this issue, the site was pushed to the web server using Adobe Dreamweaver before the customization process took place. Pushing the site to the web server places all the files related to the site on the local machine to the web server site. This site was pushed to the USC SSI web server location set aside for the developer. Dreamweaver copied the site set up and mirrored that structure on the web server.

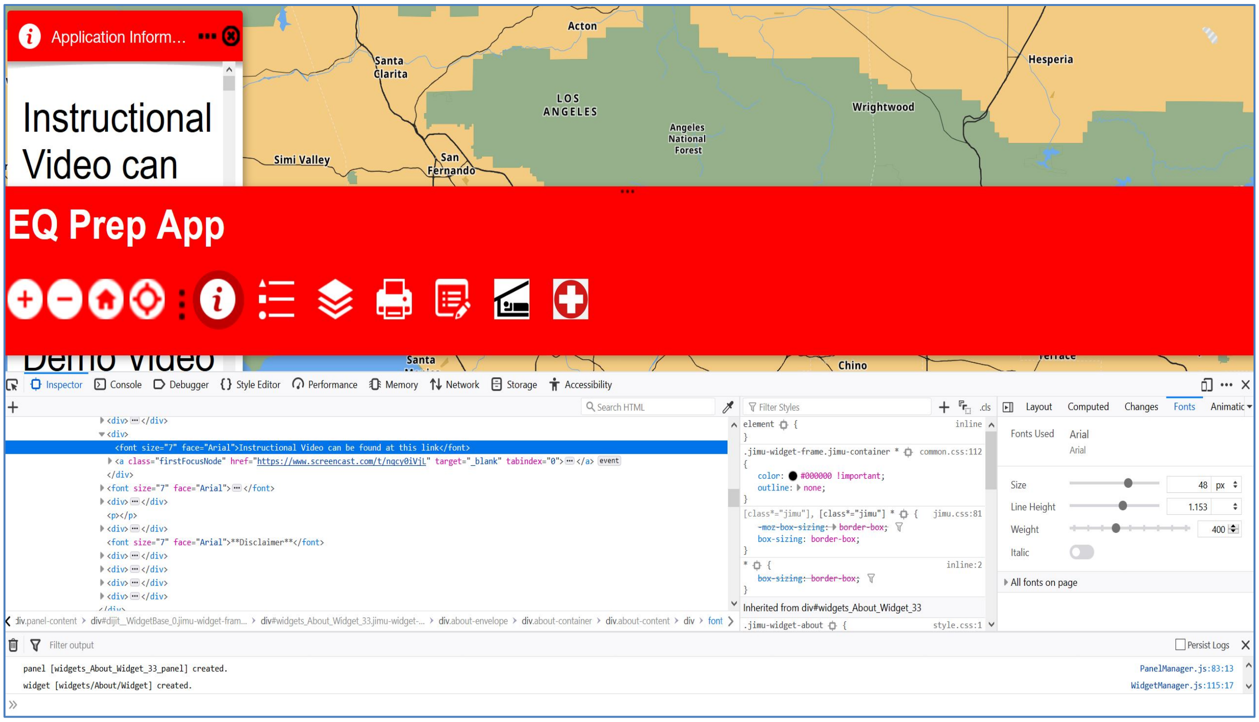
Once the application was pushed to the web server, the application had to be registered with the developer Esri account in the Esri on AGOL in order for the Esri API to work. A record had to be created for the application in AGOL, and the application ID had to be associated with the application. The application ID had to be copied from AGOL and placed in the main config JSON file. Figure 26 shows the application ID being associated in the main config file located at this location (\EQAppSite\EQPrepApp\config.json). Once the application ID was associated, the application would function properly and come up on the web server.



```
{
  "theme": {
    "name": "DartTheme",
    "styles": [
      "pink",
      "default",
      "green",
      "red",
      "turquoise",
      "blue",
      "orange",
      "purple"
    ],
    "version": "2.11",
    "sharedTheme": {
      "isPortalSupport": true,
      "useHeader": false,
      "useLogo": false
    },
    "customStyles": {
      "mainBackgroundColor": "#ff0000"
    }
  },
  "portalUrl": "https://uscssi.maps.arcgis.com",
  "appId": "gEQQds6gxehtKwlk",
  "authorizedCrossOriginDomains": [],
"title": "<div class=\"attribute-custom-style\"><font face=\"Arial\" size=\"14\"><b
style=\"\">EQ Prep App</b></font></div>",
```

Figure 26. Application ID

In order to find the code element that needed to be changed, the developer used developer inspection tools found in the Mozilla Firefox web browser package. Using this method proved more efficient than search for the correct code to change in the folder structure as some of the styling code overrides other style codes. Inspection tools were used to find the code location that needed to be customized and then the developer could make changes to the local files and then push changes to the web server. The application was refreshed to check to ensure the changes to the code brought the desired results. Figure 27 shows an example of using the inspection tools to locate the associated style file that needed to be changed.



```
▸ <div> ⋯ </div>
▾ <div>
    <font size="7" face="Arial">Instructional Video can be found at this link</font>
  ▸ <a class="firstFocusNode" href="https://www.screencast.com/t/nqcy0iVjL" target="_blank" tabindex="0"> ⋯ </a> event
  </div>
▸ <font size="7" face="Arial"> ⋯ </font>
▸ <div> ⋯ </div>
  <p></p>
▸ <div> ⋯ </div>
  <font size="7" face="Arial">**Disclaimer**</font>
▸ <div> ⋯ </div>
▸ <div> ⋯ </div>
▸ <div> ⋯ </div>
▸ <div> ⋯ </div>
</div>
```

div.panel-content › div#dijit__WidgetBase_0.jimu-widget-fram... › div#widgets_About_Widget_33.jimu-widget-... › div.about-envelope › div.about-container › div.about-content › div › font

```
element {                                              inline
}
.jimu-widget-frame.jimu-container * {          common.css:112
    color: ● #000000 !important;
    outline: ▸ none;
}
[class*="jimu"], [class*="jimu"] * {               jimu.css:81
    ~~-moz-box-sizing: ▸ border-box;~~
    box-sizing: border-box;
}
* {                                                  inline:2
    ~~box-sizing: border-box;~~
}
Inherited from div#widgets_About_Widget_33
.jimu-widget-about {                              style.css:1
```

Fonts Used: Arial

Size: 48 px

Line Height: 1.153

Weight: 400

Italic

▸ All fonts on page

```
panel [widgets_About_Widget_33_panel] created.           PanelManager.js:83:13
widget [widgets/About/Widget] created.                   WidgetManager.js:115:17
```

Figure 27. Inspection Tools

5.2. Customization of Application

The next subsections discuss the customizing process of the application code in Dreamweaver in order to meet the desired customization for user experience and interface requirements. Section 4.8.3.1 describes updating the Controller Bar and Title. Section 4.8.3.2 discusses making the changes to the widget buttons on the Controller Bar. Section 4.8.3.3 details the customization made to what is called the widget panels. Section 4.8.3.4 describes the changes made to the Legend Widget code for customization of the appearance. Section 4.8.3.5 recounts the customizations made to the Turn On/Off Layer Widget. Section 4.8.3.6 discusses the customizations made to the Nearest Widgets.

5.2.1. Updating the Application Title and Title Bar

The Dart Controller Bar is the bar at the bottom of the application that is a part of the Dart theme chosen previously. The Dart Controller Bar contains the title of the application, the controller tools, and the widget buttons to access the widgets. The out-of-the-box Dart Controller Bar settings with Web AppBuilder on AGOL had certain limitations as far as the size of the bar to expand, button size, and certain limitations on the text size. The title text could only go so large before getting cut off by the bar size. The button sizes could not be changed. Figure 28 shows the Dart Controller Bar before customization. In order to make room for a larger application title, the application dart controller bar had to be enlarged. The enlargement would also help make room for larger widget buttons in the dart controller. All of these things would need to be changed in order to meet the requirements of the application design and functionality.

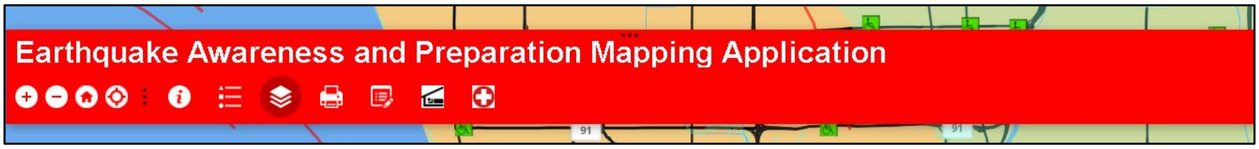
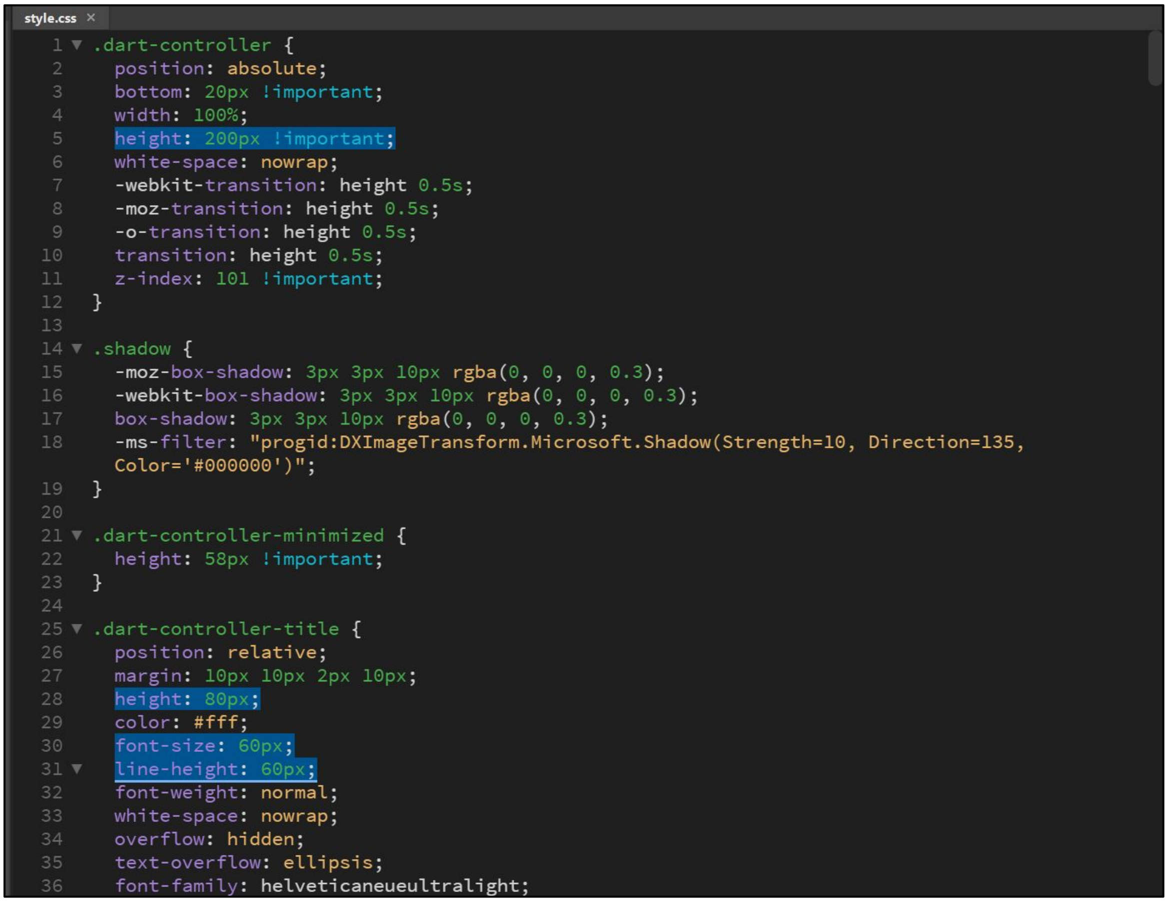


Figure 28. Controller Bar Non-Customized

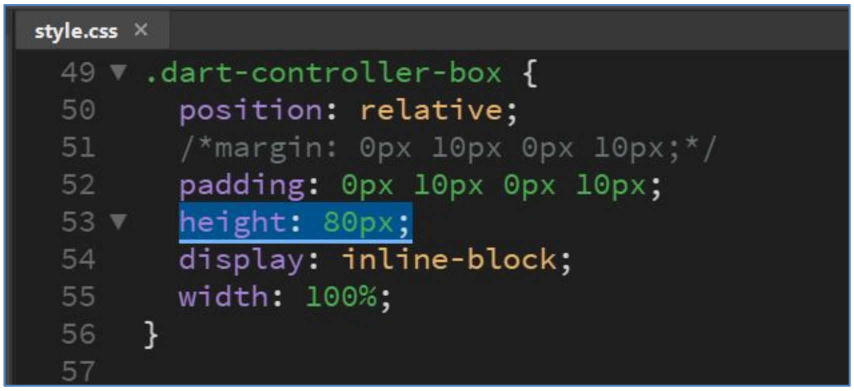
The application title size is set in the config file in the main app directory (EQAppSite\EQPrepApp\config.json). The font size was changed to 14. The font size is also controlled by the style file for the dart controller noted in the next paragraph. Different files contain code that can control the look of the application. In some cases, code in the config file is overridden by other code in different files. For example, the font size is controlled by a config file and a style file. The title was shortened during this process as "EQ Preparation Application" was too long when viewed on a mobile device. The Title was changed to EQ Prep App.

The Dart Controller Bar that contains the widgets, tools, and title had to be increased in order to make room for the larger title and to make room to increase the widget button sizes. The changes were made in the CSS file for the Dart Controller style (EQAppSite\EQPrepApp\themes\DartTheme\widgets\DartController\css\style.css). The change had to be applied to the height of the Dart Controller. The Dart Controller height size was changed to 200px. The Dart Controller title height size was changed to 80px. The font size and line height for the title were both changed to 60px (Figure 29). The Dart Controller box height was changed to 80px (Figure 30).



```
.dart-controller {
  position: absolute;
  bottom: 20px !important;
  width: 100%;
  height: 200px !important;
  white-space: nowrap;
  -webkit-transition: height 0.5s;
  -moz-transition: height 0.5s;
  -o-transition: height 0.5s;
  transition: height 0.5s;
  z-index: 101 !important;
}

.shadow {
  -moz-box-shadow: 3px 3px 10px rgba(0, 0, 0, 0.3);
  -webkit-box-shadow: 3px 3px 10px rgba(0, 0, 0, 0.3);
  box-shadow: 3px 3px 10px rgba(0, 0, 0, 0.3);
  -ms-filter: "progid:DXImageTransform.Microsoft.Shadow(Strength=10, Direction=135, Color='#000000')";
}

.dart-controller-minimized {
  height: 58px !important;
}

.dart-controller-title {
  position: relative;
  margin: 10px 10px 2px 10px;
  height: 80px;
  color: #fff;
  font-size: 60px;
  line-height: 60px;
  font-weight: normal;
  white-space: nowrap;
  overflow: hidden;
  text-overflow: ellipsis;
  font-family: helveticaneueultralight;
```

Figure 29. Dart Controller Title and Box Code



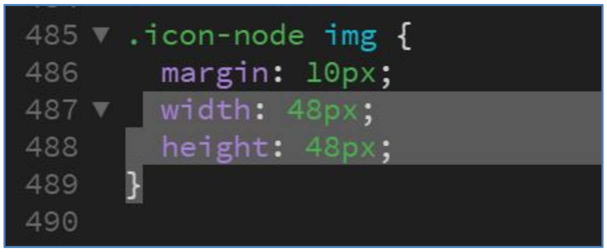
```
.dart-controller-box {
  position: relative;
  /*margin: 0px 10px 0px 10px;*/
  padding: 0px 10px 0px 10px;
  height: 80px;
  display: inline-block;
  width: 100%;
}

```

Figure 30. Dart Controller Box Code Changes

5.2.2. Customizing Widget Button Sizes on the Dart Controller

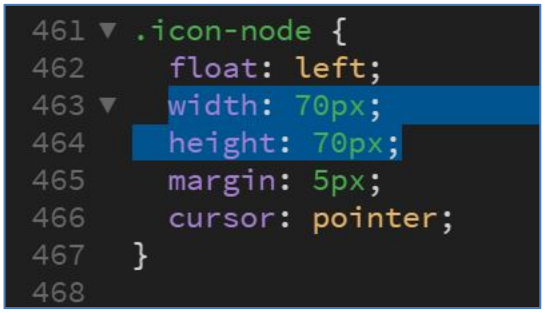
The next step in the customization process was to make the widget buttons in the dart controller larger. The two different groups of widget buttons were the tools widgets and the other widgets. The widget buttons were separated by an ellipsis on the dart controller bar that collapses the other widgets. The tool widget buttons were on the left side of the ellipses, and the other widget buttons were located on the right side of the ellipse. The two different groups of widget buttons were styled separately.

The widget buttons that were to the right of the ellipses were only 24px by 24px in the base application. The buttons were doubled in size to make them easier to see and to click. The code had to be customized in a few different files in order to make the desired changes. The dart controller widget style file (\EQAppSite\EQPrepApp\themes\DartTheme\widgets\DartController\css\style.css), had to be edited as well as the JavaScript (\EQAppSite\EQPrepApp\themes\DartTheme\widgets\DartController\widget.js). The button icon node image width and height were change to 48px in the style file (Figure 31). Icon node image controls how large the image was for those specific widget buttons on the Dart Controller Bar. The icon node was changed in the style.css file from 44px by 44px to 70p by 70px for buttons in order to make the buttons larger (Figure 32). Height was added to change the height to 80px in the widget JavaScript file in order to make room for the larger widget buttons for the action (Figure 33).



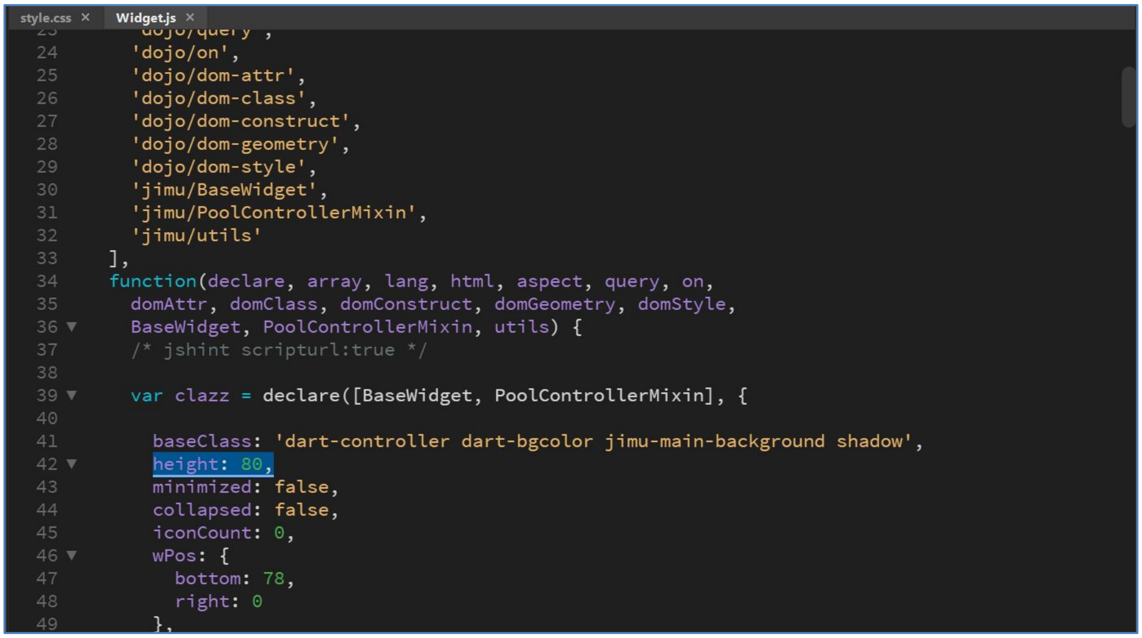
```css
.icon-node img {
  margin: 10px;
  width: 48px;
  height: 48px;
}
```

Figure 31. Icon Node Image Code



```css
.icon-node {
  float: left;
  width: 70px;
  height: 70px;
  margin: 5px;
  cursor: pointer;
}
```

Figure 32. Icon Node Code

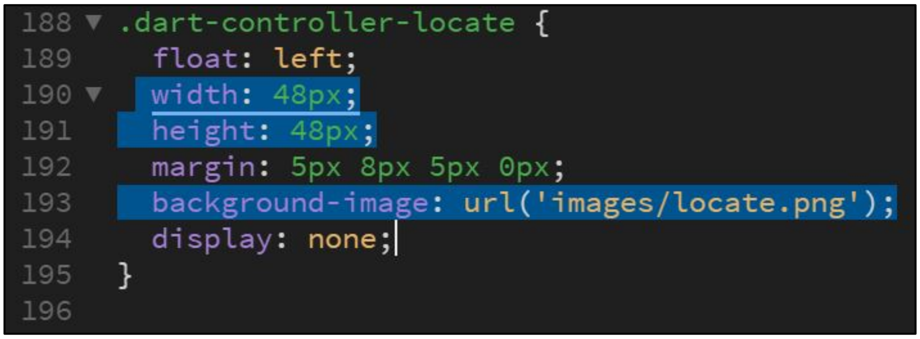


```javascript
  'dojo/query',
  'dojo/on',
  'dojo/dom-attr',
  'dojo/dom-class',
  'dojo/dom-construct',
  'dojo/dom-geometry',
  'dojo/dom-style',
  'jimu/BaseWidget',
  'jimu/PoolControllerMixin',
  'jimu/utils'
],
function(declare, array, lang, html, aspect, query, on,
  domAttr, domClass, domConstruct, domGeometry, domStyle,
  BaseWidget, PoolControllerMixin, utils) {
  /* jshint scripturl:true */

  var clazz = declare([BaseWidget, PoolControllerMixin], {

    baseClass: 'dart-controller dart-bgcolor jimu-main-background shadow',
    height: 80,
    minimized: false,
    collapsed: false,
    iconCount: 0,
    wPos: {
      bottom: 78,
      right: 0
    },
```

Figure 33. Dart Controller Widget JavaScript Code

The widgets button icons in the toolbox on the dart controller to the left of the ellipsis had to be individually increased from 24px by 24px to 48px by 48px (Figure 34). The images for the buttons also were increased in pixel size from 24px by 24px to 48px by 48px using Adobe

Photoshop (Figure 35) Icon node is the button that is pushed. The images for the icon buttons are sourced from image files in the application folders. If the image sizes were not changed, the images would have been distorted within the button icon. Instead of being a single image that would make sense, the image would have been multiplied into rows to fit the size of the button rather than just expanding to fit the new increase button size. This process was followed for the Locate, Home, Zoom, and Zoom Out buttons. The container for the dart controller tools also had to be increased to make room for the increase in size (Figure 36).



```
.dart-controller-locate {
  float: left;
  width: 48px;
  height: 48px;
  margin: 5px 8px 5px 0px;
  background-image: url('images/locate.png');
  display: none;
}
```

Figure 34. Location Widget Button CSS

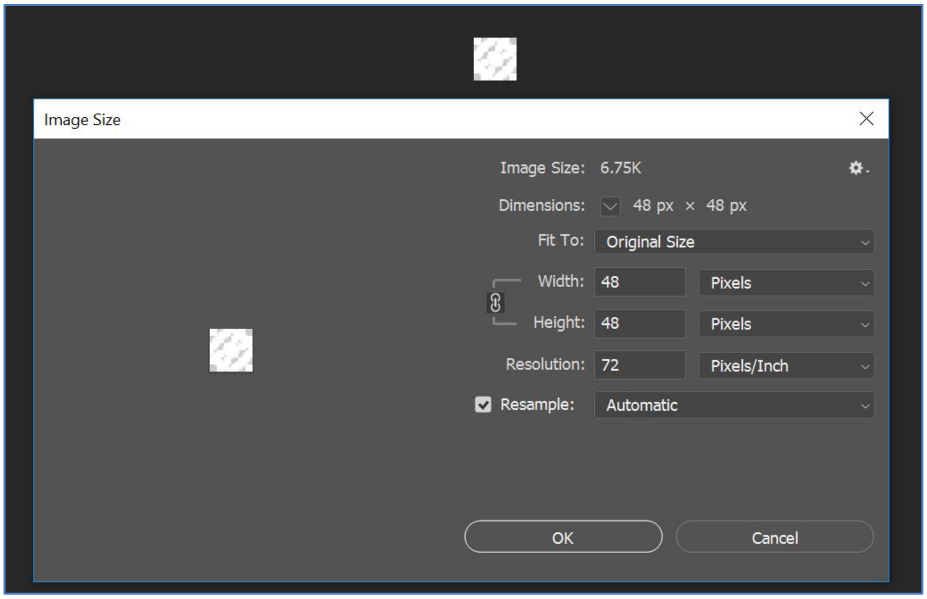


Image Size

Image Size: 6.75K

Dimensions: 48 px × 48 px

Fit To: Original Size

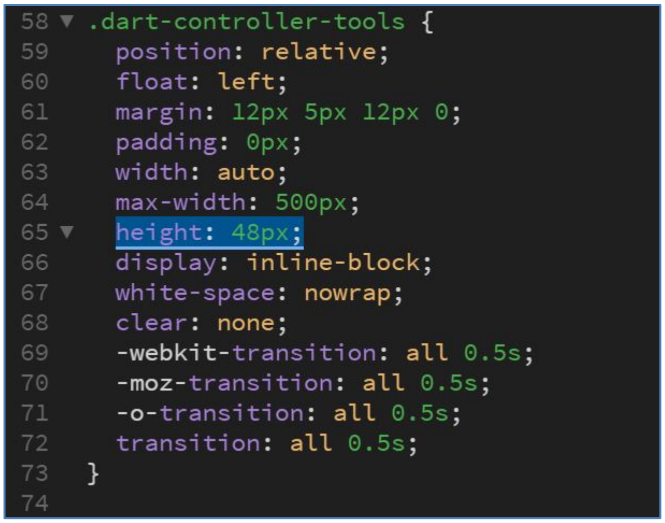
Width: 48 Pixels

Height: 48 Pixels

Resolution: 72 Pixels/Inch

☑ Resample: Automatic

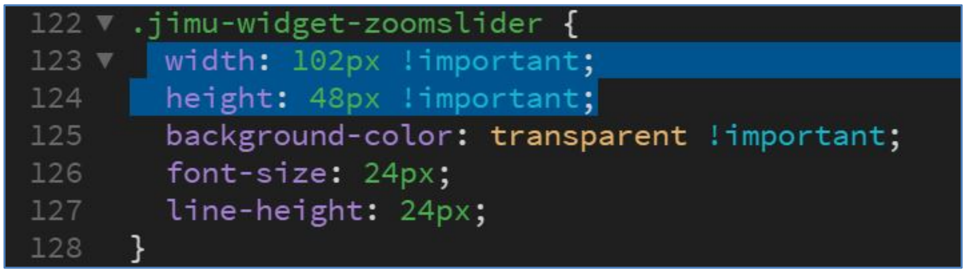
Figure 35. Image Size Change



```
.dart-controller-tools {
  position: relative;
  float: left;
  margin: 12px 5px 12px 0;
  padding: 0px;
  width: auto;
  max-width: 500px;
  height: 48px;
  display: inline-block;
  white-space: nowrap;
  clear: none;
  -webkit-transition: all 0.5s;
  -moz-transition: all 0.5s;
  -o-transition: all 0.5s;
  transition: all 0.5s;
}
```

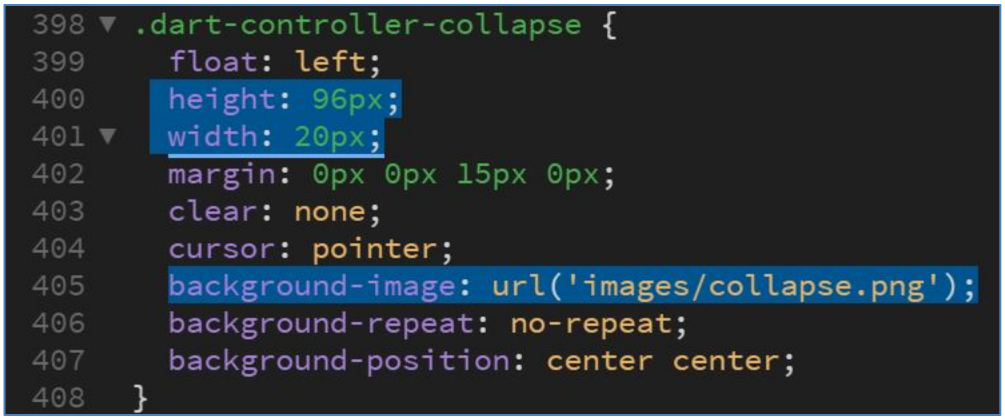
Figure 36. Dart Controller Tools Box

The zoom slider button contains both the zoom in and zoom out buttons. Both of those buttons were doubled in size, and the zoom slider itself had to be increased accordingly (Figure 37). The collapse ellipse button between the toolbox widgets and other widgets was also increased in size in order to match the sizing of the widgets and to make the button easier to click on to collapse the widgets buttons (Figure 38).



```
.jimu-widget-zoomslider {
  width: 102px !important;
  height: 48px !important;
  background-color: transparent !important;
  font-size: 24px;
  line-height: 24px;
}
```

Figure 37. Zoom Slider Changes



```
.dart-controller-collapse {
  float: left;
  height: 96px;
  width: 20px;
  margin: 0px 0px 15px 0px;
  clear: none;
  cursor: pointer;
  background-image: url('images/collapse.png');
  background-repeat: no-repeat;
  background-position: center center;
}
```

Figure 38. Ellipsis Collapse Changes

The final widget bar contained a double sized bar, title, and widget buttons with a red background and white text for high contrast and larger symbols and text (Figure 39). The text and buttons should be easy to use. The on-hover text was not able to be changed because the code was unavailable to be customized. On most browsers, the size of the bar can also be changed by setting the zoom scale on the browser to be larger or smaller. This larger default setting allows for this bar and buttons to be larger upon default to make the process easier rather having to have to find the zoom scale on the browser. The controller bar on smaller mobile devices was too large and covered up a large portion of the screen (Figure 40). The widgets buttons also must be swiped to see all the buttons. The title was also shortened so that the title could be larger and still displayed on multiple screens sizes.

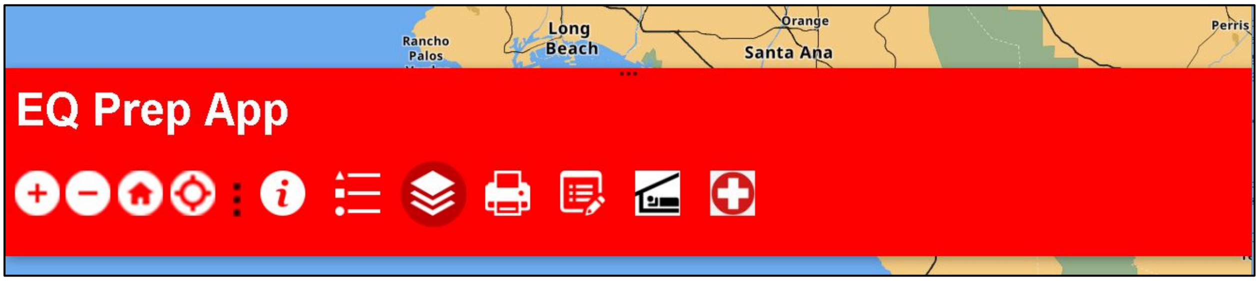


Figure 39. Customized Controller Bar

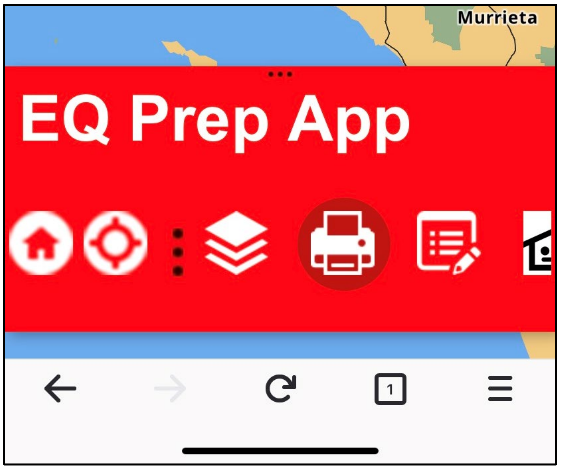
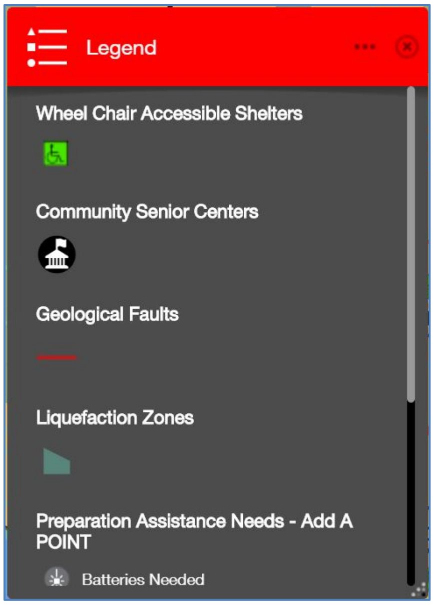


Figure 40. Customized Bar on Mobile Device

5.2.3. Customizing the Widget Panel

The widget panel is a window that contains the information that appears when a widget button is clicked. The top of the widget panel has a title and buttons to close and minimize the panel. The handle is the top of the window that contains the panel title, minimize button and close button. The original non-customized widget panels all had dark grey backgrounds with small white text and small dark grey close and minimize buttons. Figure 41 shows an example of one of the widget panels before customization. The widget panel was customized to give all of the widget panels a new look in order to meet the requirements for application design of larger text, contrasting colors, and easier to use buttons.



Legend

Wheel Chair Accessible Shelters

Community Senior Centers

Geological Faults

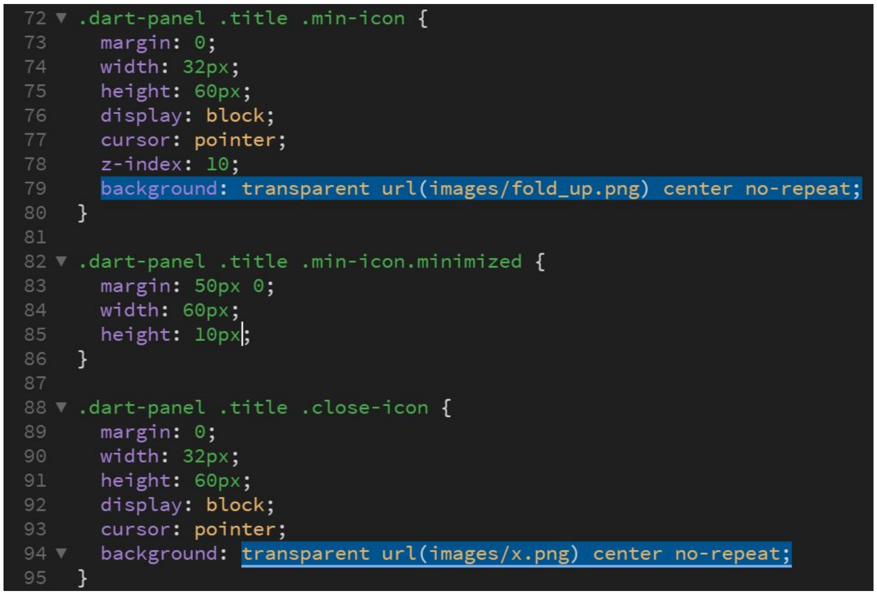
Liquefaction Zones

Preparation Assistance Needs - Add A POINT

Batteries Needed

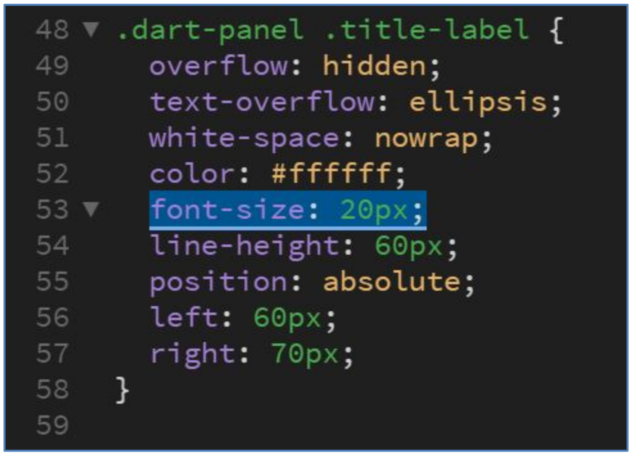
Figure 41. Widget Panel Before Customization

Changes to the panel handle were made in the panel CSS file that is located here: (\EQAppSite\EQPrepApp\themes\DartTheme\panels\DartPanel\style.css). The panel title size was made larger, and the panel close and minimize buttons colors were made darker to contrast better against the red. The buttons were changed from light gray to dark black (Figure 42). Adobe Photoshop was used to change the image colors. The font size on the title label was changed to 20px from 16px. The font color was changed to white from black (Figure 43). The widget panel handle also was increased to accommodate the larger title and buttons (Figure 44).



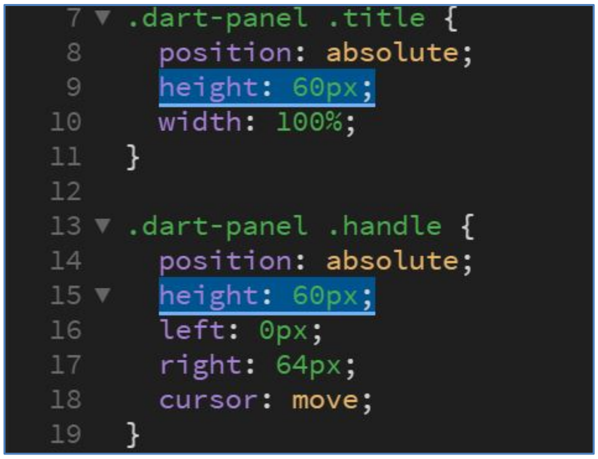
```
.dart-panel .title .min-icon {
  margin: 0;
  width: 32px;
  height: 60px;
  display: block;
  cursor: pointer;
  z-index: 10;
  background: transparent url(images/fold_up.png) center no-repeat;
}

.dart-panel .title .min-icon.minimized {
  margin: 50px 0;
  width: 60px;
  height: 10px;
}

.dart-panel .title .close-icon {
  margin: 0;
  width: 32px;
  height: 60px;
  display: block;
  cursor: pointer;
  background: transparent url(images/x.png) center no-repeat;
}
```

Figure 42. Minimize and Close Icon Changes



```
.dart-panel .title-label {
  overflow: hidden;
  text-overflow: ellipsis;
  white-space: nowrap;
  color: #ffffff;
  font-size: 20px;
  line-height: 60px;
  position: absolute;
  left: 60px;
  right: 70px;
}
```

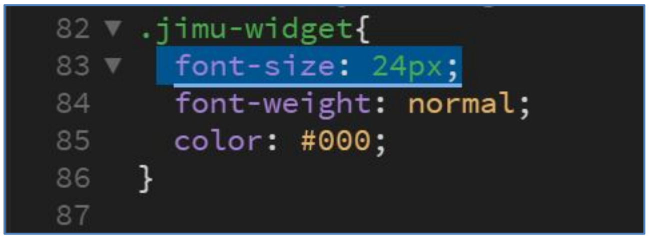
Figure 43: Widget Panel Title Style Code



```
 7 ▼ .dart-panel .title {
 8      position: absolute;
 9      height: 60px;
10      width: 100%;
11   }
12
13 ▼ .dart-panel .handle {
14      position: absolute;
15 ▼    height: 60px;
16      left: 0px;
17      right: 64px;
18      cursor: move;
19   }
```

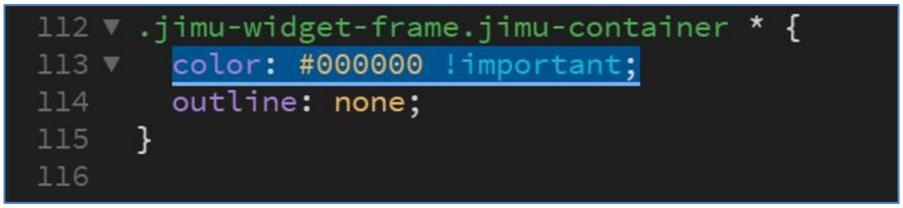
Figure 44. Changes to Panel Widget Handle

The text in the content of the panel was changed from white to black, and the background of the content pane was changed from grey to a white for better visual contrast. The font size of the panel text was increased from 12px to 24px on line 83 in the CSS file (\EQAppSite\EQPrepApp\jimu.js\css\jimu-theme.css)(Figure 45). The panel content text color was changed from white to black by changing line 113 in the common CSS file in the dart theme folder (\EQAppSite\EQPrepApp\themes\DartTheme\common.css) (Figure 46). The panel content background was changed from dark gray to white by changing the code to line 107 in the CSS file in the dart theme panel folder (\EQAppSite\EQPrepApp\themes\DartTheme\panels\DartPanel\style.css)(Figure 47)



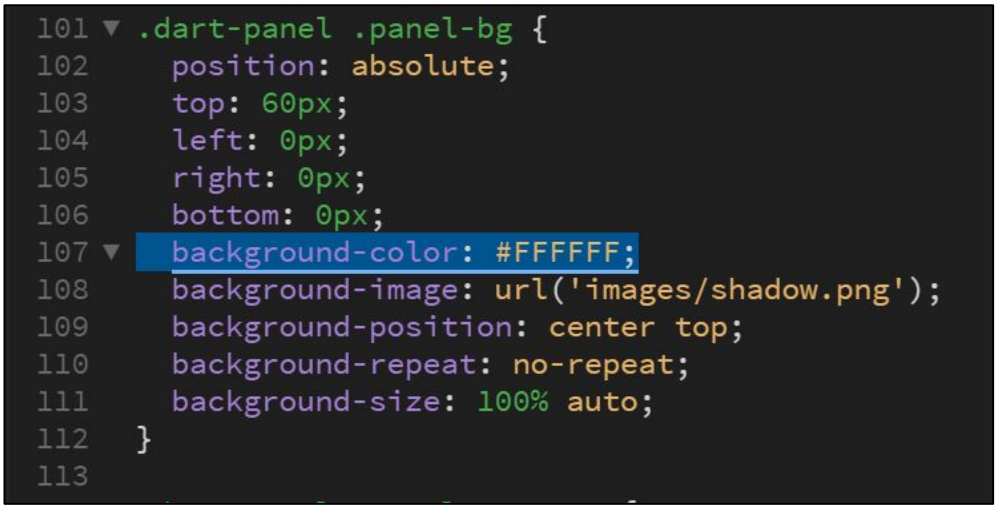
```
82 ▼ .jimu-widget{
83 ▼   font-size: 24px;
84     font-weight: normal;
85     color: #000;
86   }
87
```

Figure 45. Widget Panel Content Text Size



```
.jimu-widget-frame.jimu-container * {
  color: #000000 !important;
  outline: none;
}

```

Figure 46. Widget Panel Content Text Color

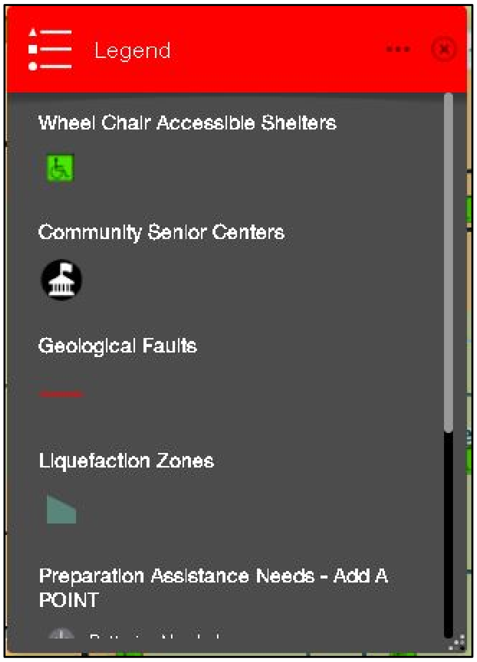


```
.dart-panel .panel-bg {
  position: absolute;
  top: 60px;
  left: 0px;
  right: 0px;
  bottom: 0px;
  background-color: #FFFFFF;
  background-image: url('images/shadow.png');
  background-position: center top;
  background-repeat: no-repeat;
  background-size: 100% auto;
}

```

Figure 47. Dart Panel Background

5.2.4. Customizing the Legend Widget

The next step in the customization of the application was the customization of the Legend widget. The original non-customized widget featured a dark grey background, white text, smaller font, and dark grey close and minimize boxes (Figure 48). The changes to the background colors and close and minimize were done in the customization of the widget panel section. Changes applied there apply to all of the widget panels. The Legend text style is set in the Legend CSS file in the widget directory (\EQAppSite\EQPrepApp\widgets\Legend\css\style.css). The default font size for this widget was 12px. The widget font size was increased to 24px for increased readability (Figure 49). The layer symbols in the Legend were not able to be changed in the code in order to make the symbols larger. The final Legend widget displayed larger black text with a white background and black close and minimize buttons (Figure 50).



Legend

Wheel Chair Accessible Shelters

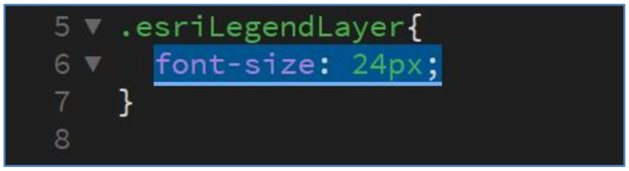
Community Senior Centers

Geological Faults

Liquefaction Zones

Preparation Assistance Needs - Add A POINT

Figure 48. The Legend Before



```
.esriLegendLayer{
    font-size: 24px;
}
```

Figure 49. Legend Font Style Code Change

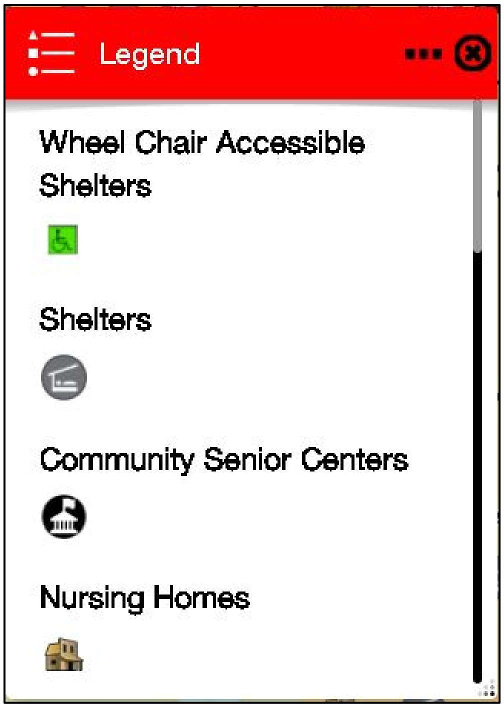
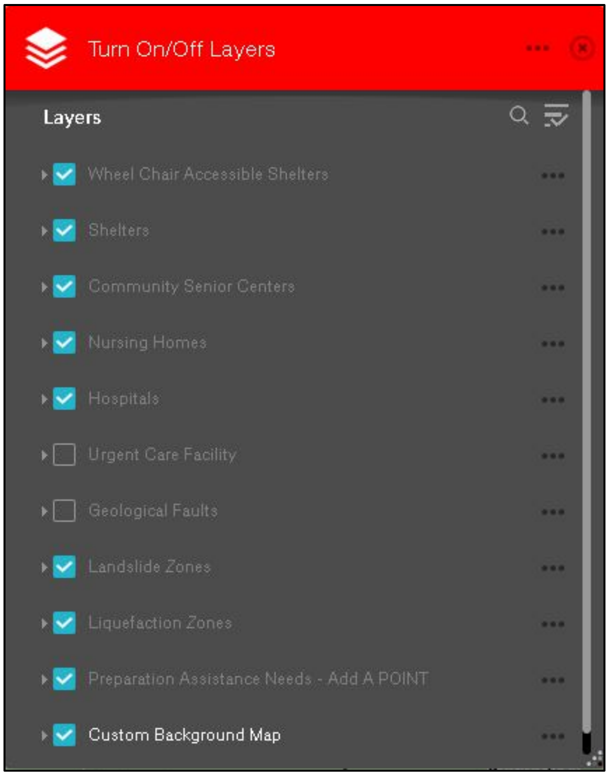


Figure 50. Legend After

5.2.5. Customizing the Turn On/Off Layers Widget

The Turn On/Off Layers Widget panel displays a layer list with checkboxes beside each layer name for turning each on and off. The original non-customized Turn On/Off Layers widget panel displayed a grey background with white font and small text (Figure 51). The original non-customized Turn On/Off Layers Widget also displayed dark grey close and minimize buttons and smaller check boxes with white check marks. The panel color and close and minimize buttons were previously customized in the step to customize the widget panels discussed in 4.6.3.3.

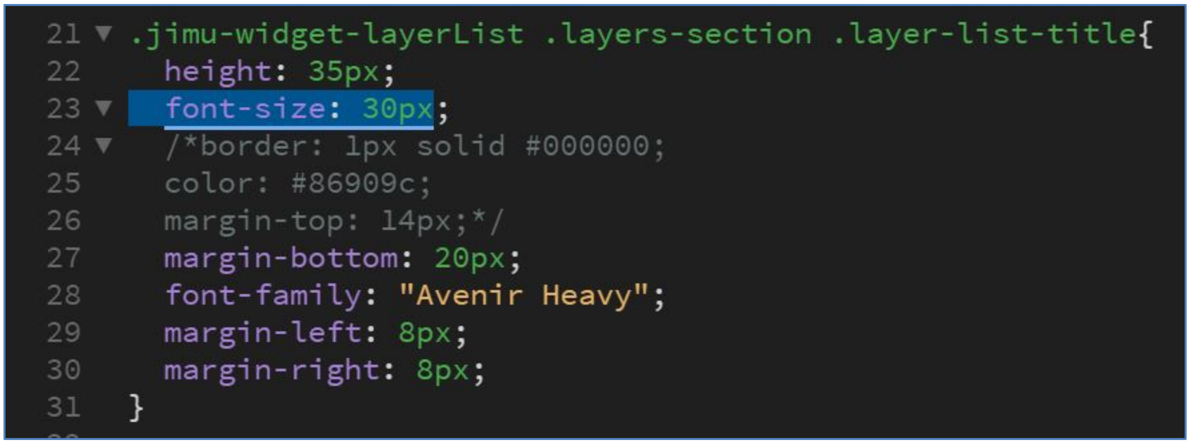

Turn On/Off Layers

Layers

- ☑ Wheel Chair Accessible Shelters
- ☑ Shelters
- ☑ Community Senior Centers
- ☑ Nursing Homes
- ☑ Hospitals
- □ Urgent Care Facility
- □ Geological Faults
- ☑ Landslide Zones
- ☑ Liquefaction Zones
- ☑ Preparation Assistance Needs - Add A POINT
- ☑ Custom Background Map

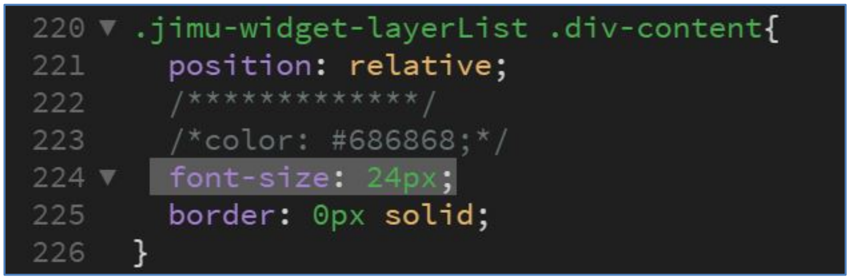
Figure 51. Turn On/Off Layers Widget Before

In order to make further customizations to the Turn On/Off Layers Widget, the styling would need to be changed to the widget style file. The styling for the text size and checkboxes is set in the layer list files in the layer list widget directory of the application (\EQAppSite\EQPrepApp\widgets\LayerList\css\style.css). The layer list title text size was increased from 14px to 30px in order to make the title of the layer list stand out and be clearly readable (Figure 52). The layer list item font size was changed from 12px to 24px (Figure 53).



```
.jimu-widget-layerList .layers-section .layer-list-title{
  height: 35px;
  font-size: 30px;
  /*border: 1px solid #000000;
  color: #86909c;
  margin-top: 14px;*/
  margin-bottom: 20px;
  font-family: "Avenir Heavy";
  margin-left: 8px;
  margin-right: 8px;
}
```

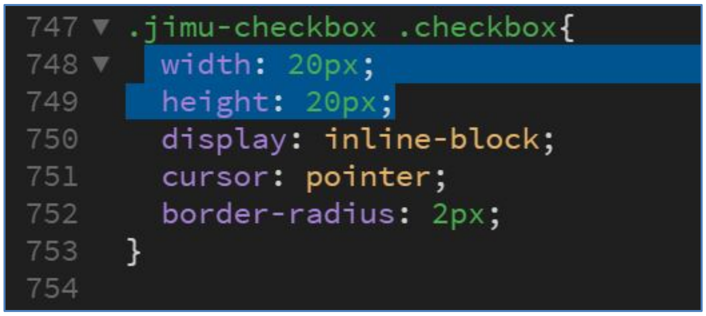
Figure 52. Layer List Title Code



```
.jimu-widget-layerList .div-content{
  position: relative;
  /*************/
  /*color: #686868;*/
  font-size: 24px;
  border: 0px solid;
}
```

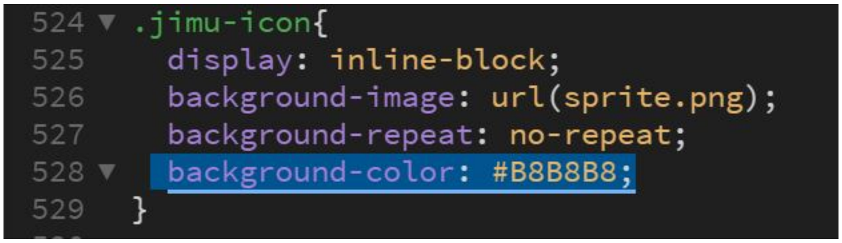
Figure 53. Layer List Content Text Size Code

The checkboxes were changed in color and in size for easier interaction. The changes to the checkboxes were made in the jimu.js style CSS file (\EQAppSite\EQPrepApp\jimu.js\css\style.css) The size of the checkbox was increased from 16px to 20px (Figure 54). Changing the size to any larger resulted in errors with the line sizing. The colors were changed to black check marks in white boxes from white check marks against light blue boxes when checked. When unchecked, the colors were changed from grey boxes with a white outline to a grey box with no outline against the now white panel background (Figure 55).



```
.jimu-checkbox .checkbox{
  width: 20px;
  height: 20px;
  display: inline-block;
  cursor: pointer;
  border-radius: 2px;
}
```

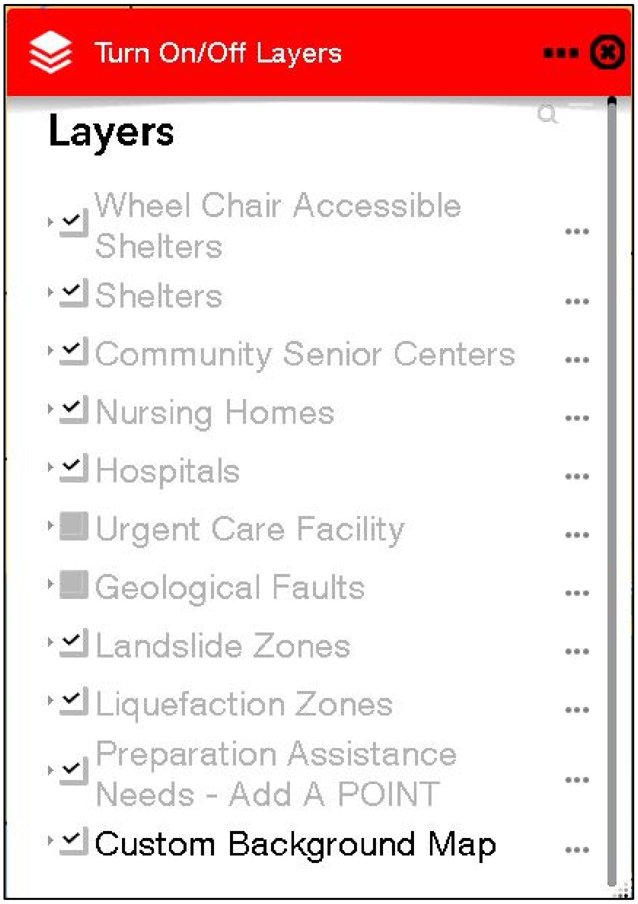
Figure 54. Checkbox Size Change



```
.jimu-icon{
  display: inline-block;
  background-image: url(sprite.png);
  background-repeat: no-repeat;
  background-color: #B8B8B8;
}
```

Figure 55. Checkbox Background Color Change

The final Turn On/Off layers, widget featured customized title bar with increased title font size and customized close and minimize buttons with larger, darker black icons that were made to give more contrast and more area for interacting with the buttons. The widget panel also featured the customized font sizes that were increased in size in order to make the text more legible for those that have trouble reading smaller font. The final widget panel also featured a white background and black text instead of the normal grey background with white text to increase contrast in order to make the text easier to read. The final widget panel for the turn on/off widget also featured customized checkboxes for increased visualization for interactivity (Figure 56).



Layers

- ☑ Wheel Chair Accessible Shelters
- ☑ Shelters
- ☑ Community Senior Centers
- ☑ Nursing Homes
- ☑ Hospitals
- □ Urgent Care Facility
- □ Geological Faults
- ☑ Landslide Zones
- ☑ Liquefaction Zones
- ☑ Preparation Assistance Needs - Add A POINT
- ☑ Custom Background Map

Figure 56. Turn On/Off Layer Widget After

5.2.6. Customizing the Nearest Widgets

Next, the buttons within Nearest Emergency Services and Nearest Shelters widget panels were both were customized. Although each widget interacts on different map layers, both of the Near Me widgets are both affect by the same styling codes, so both widgets look the same except for the information returned and the icons on the dart controller bar mentioned before. Within the widget panels, a button that looks like a balloon is located on the right side of the panel. When the button is not clicked, the user must enter a location in the search box of the panel. If the balloon button is clicked on, then the user can choose a location on the map to search on, With the base application out-of-the-box code, the balloon button when turned off did not show clearly in the base application because it blended with the panel background. The balloon was greyed out; and when clicked and turned on, the balloon color was turned to white with a white outline which also matches the new panel background that was customized. The balloon size was also smaller and harder to see when turned on in the base application (Figure 57).

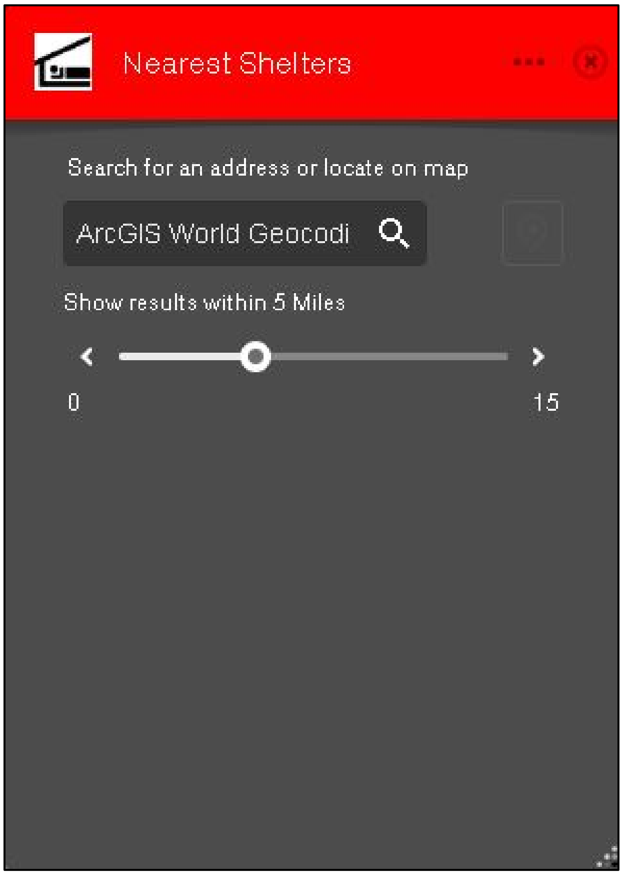
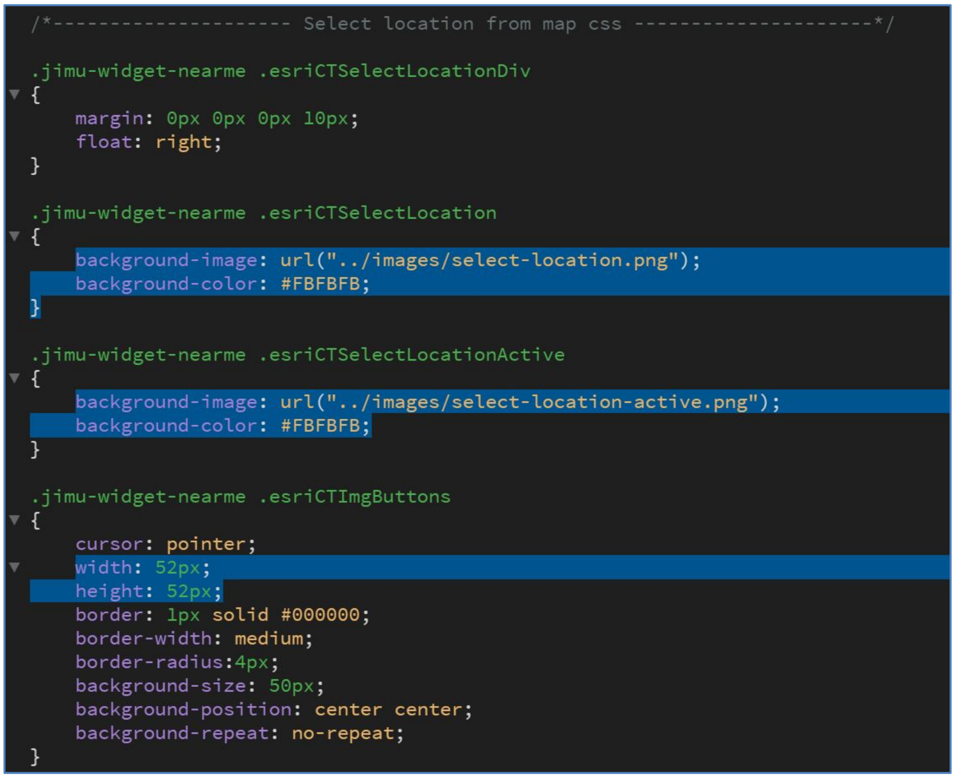

Nearest Shelters
Search for an address or locate on map
ArcGIS World Geocodi
Show results within 5 Miles
0
15

Figure 57. Nearest Shelters Widget Before

In order to make further customizations, the style files of Near Me Widget folder had to be edited and customized. The nearest widget styling code is found in the widget CSS file in the Near Me Widget folder (EQAppSite\EQPrepApp\widgets\NearMe\css\sytle.css) The button was changed to be balloon while when turned off so that it would show up even when off. This would help prevent confusion in how to turn it on. When turned on, the balloon color was changed to green because green often represents something that is on. The developer made the changes in the color of the balloon icon image files with Adobe Photoshop. The image files were sourced from the application files older. The balloon icon size was changed from 32px to 52px for easier identification (Figure 58).



```
/*-------------------- Select location from map css --------------------*/

.jimu-widget-nearme .esriCTSelectLocationDiv
{
    margin: 0px 0px 0px 10px;
    float: right;
}

.jimu-widget-nearme .esriCTSelectLocation
{
    background-image: url("../images/select-location.png");
    background-color: #FBFBFB;
}

.jimu-widget-nearme .esriCTSelectLocationActive
{
    background-image: url("../images/select-location-active.png");
    background-color: #FBFBFB;
}

.jimu-widget-nearme .esriCTImgButtons
{
    cursor: pointer;
    width: 52px;
    height: 52px;
    border: 1px solid #000000;
    border-width: medium;
    border-radius:4px;
    background-size: 50px;
    background-position: center center;
    background-repeat: no-repeat;
}
```

Figure 58. Nearest Widget Balloon Code

The final nearest widget displays for both the Nearest Emergency Service Widget and Nearest Shelters Widget (Figure 59) featured the same layout and design interacting upon different feature layers. Both widgets featured increased font size of the titles and darkened and enlarged close and minimize buttons. The nearest widgets featured changes to the location picker balloon that allows the user to pick a location on the map rather than to search a location in the search bar by address. The balloon customization featured a change to the off and on-color of the balloon in order to make the balloon easier to see and understand that the feature was turned on versus off. The widget panels also featured changes to the background color and the text color in order for the text to contrast more. The list picker also featured changes to the fonts and background color for more contrast.

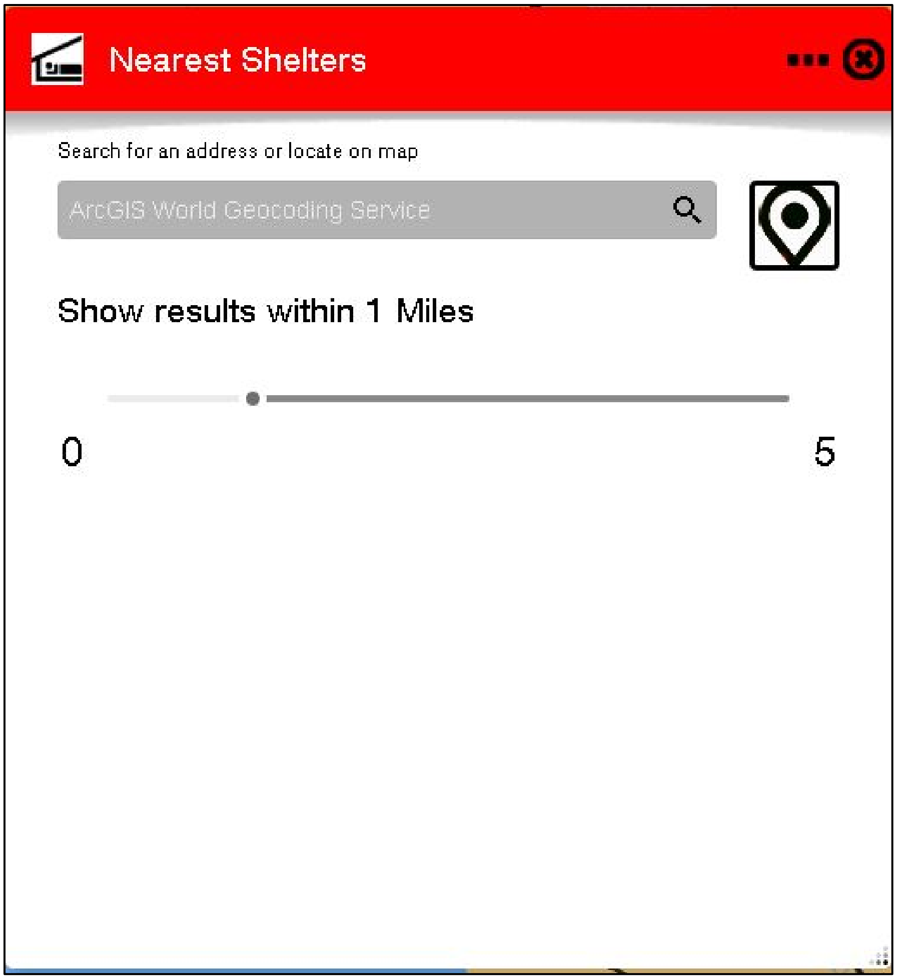

Nearest Shelters
Search for an address or locate on map
ArcGIS World Geocoding Service
Show results within 1 Miles
0
5

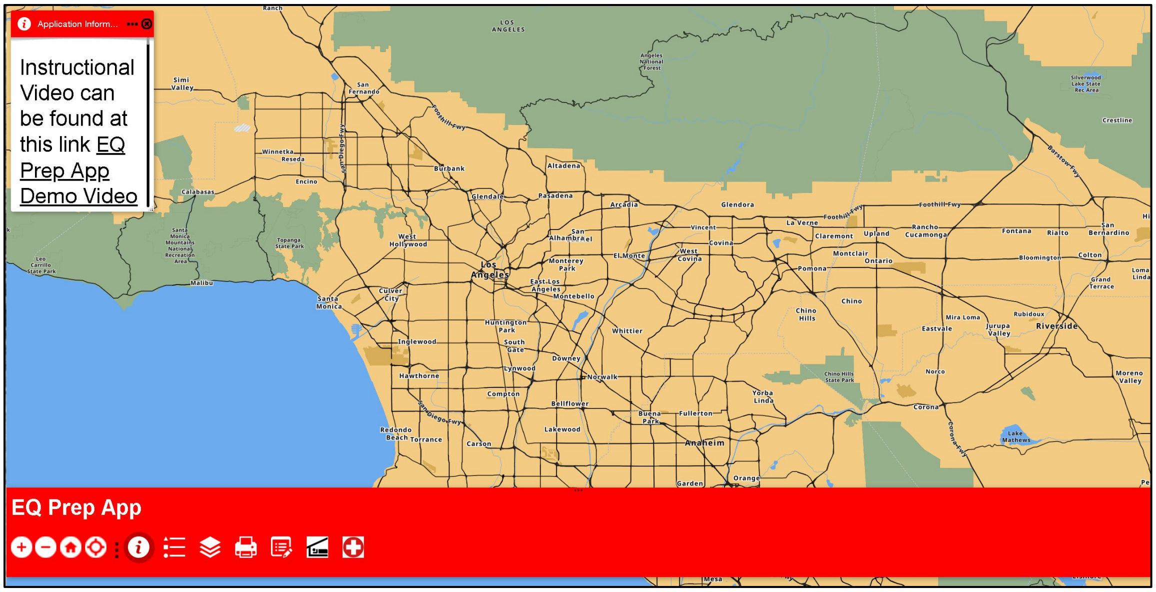
Figure 59. Nearest Shelters Widget After

Chapter 6 Results

This chapter describes the final customized application, the training documents and video, and the results of the application test with the focus group. Section 6.1 discusses the application results of design changes. Section 6.2 shows the functionality use results. Section 6.3 describes the application training material. Section 6.4 discusses the results of the focus group application test.

6.1. Final Application Design and Use Examples

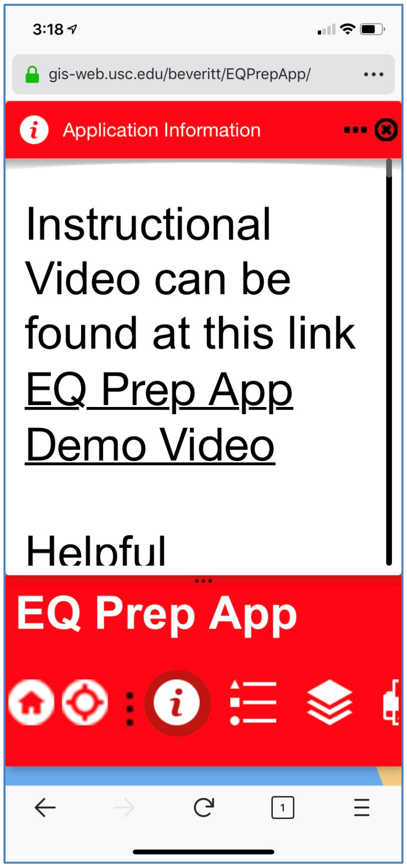
Upon completion of the development process, the application was hosted on the USC SSI web server at the following URL: https://gis-web.usc.edu/beveritt/EQPrepApp/ (available May 31, 2019). The completed application features a map display along with widgets to accomplish functional tasks. The application was customized with UI and UX considerations for older adults in order to make the application more user-friendly. The application was designed for both laptop/desktop viewing shown in Figure 60 and from a smaller mobile device as shown in Figure 61. The following subsections discuss examples of the use of the application and widgets. Section 6.1.1 shows the Application Information Widget. Section 6.1.2 provides examples of the interactivity with the Zoom Slider, Home, and Location Widgets. Section 6.1.3 demonstrates the use of the Turn On/Off Layers Widget. Section 6.1.4 details the use of identifying a feature with the legend and a pop-up. Section 6.1.5 illustrates use of the Print Widget. Section 6.1.6 demonstrates the use of the Add Assistance Request Point Widget. Lastly, section 6.1.7 shows how to use the Nearest Shelters Widget.



Instructional Video can be found at this link EQ Prep App Demo Video

EQ Prep App

Figure 60. Final Application Home Page



Application Information

Instructional Video can be found at this link EQ Prep App Demo Video

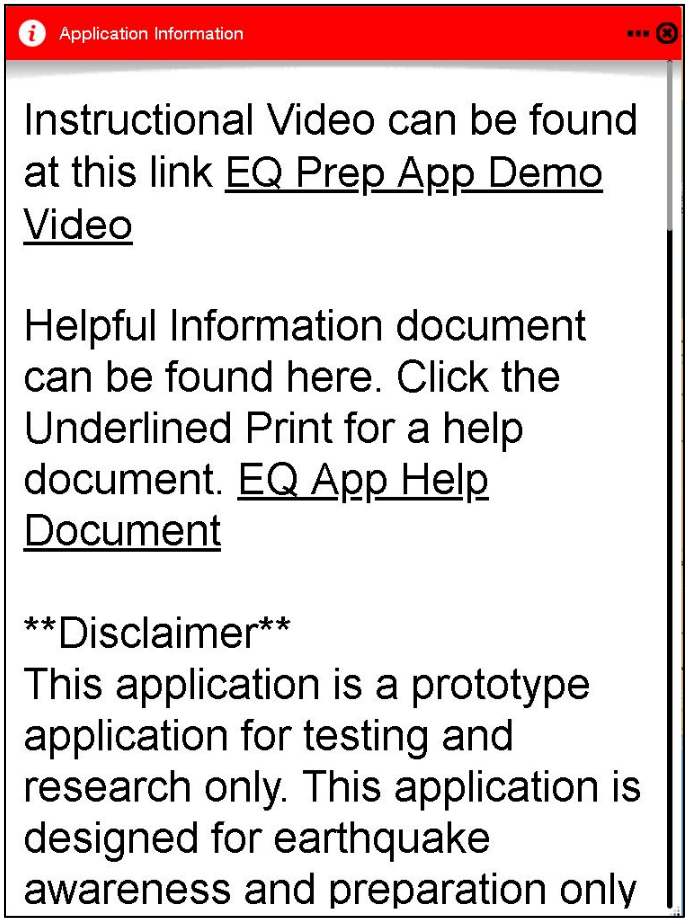
Helpful

EQ Prep App

Figure 61. Final Application Mobile

6.1.1. Final Application Information Widget Display

When a user opens the application, the Application Information Widget is displayed (Figure 62). The final Application Information widget displayed information in the text with links for the help document and the demo video. The information in the widget also displayed disclaimers as to what actually was in the application and about the design and purpose of the application. The widget was programmed so that the panel would open upon starting the application so that the user could use the links to the demo video and help document that explains the application parts and functionality. The panel could be closed after reading.



Instructional Video can be found at this link EQ Prep App Demo Video

Helpful Information document can be found here. Click the Underlined Print for a help document. EQ App Help Document

Disclaimer
This application is a prototype application for testing and research only. This application is designed for earthquake awareness and preparation only

Figure 62. Application Information Widget

6.1.2. Example of Zoom Slider, Home, and Location Widgets.

The design functionality was to allow the intended users to be able to zoom around the map, zoom to their location, and allow the user to return the map to the default location. This section describes the use of those buttons in the final application. The user pushes the Zoom-In button in order to make the mapping application zoom in, and the user pushes the zoom out button to make the map zoom out (Figure 63). When the map is zoomed in, more detail and map layers appear on the map (Figure 64). When the user uses the Location Widget, the map zooms the user's device location (Figure 65). When the user wants to get back to the default map extent (Figure 66) when they opened the EQ Prep App, the user clicks the Home button (Figure 67).

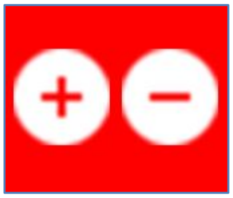


Figure 63. Zoom Slider Widget

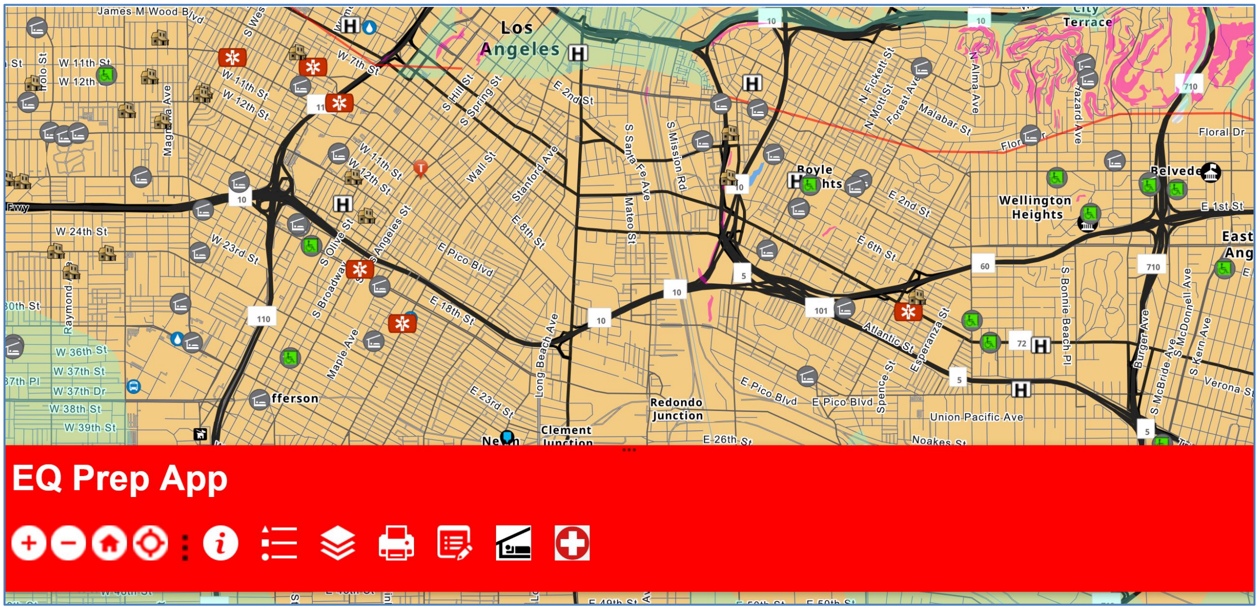
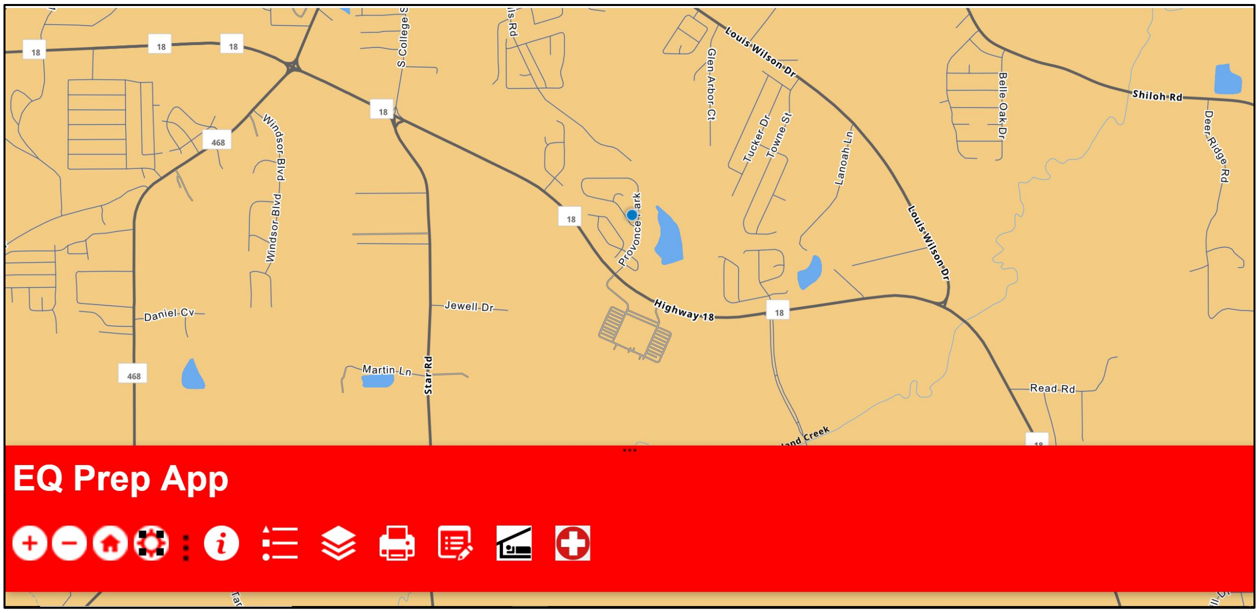
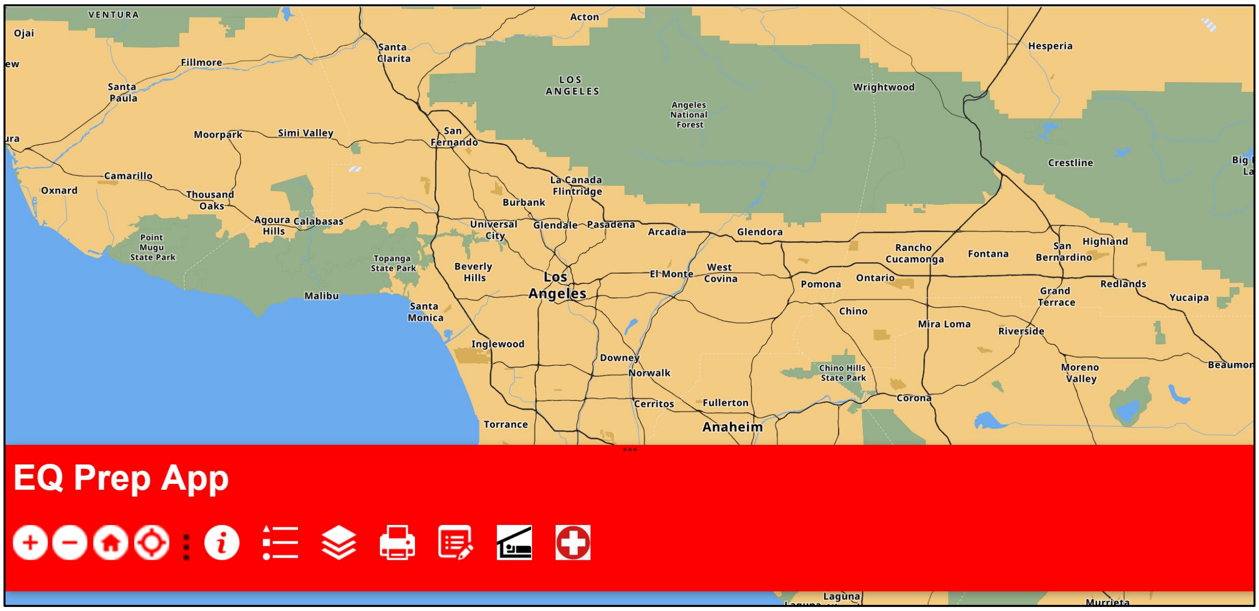


Figure 64. Zoomed in Map



EQ Prep App

Figure 65. Zoomed to Device Location



EQ Prep App

Figure 66. Default Map Extent

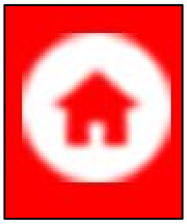


Figure 67. Home Button

6.1.3. Turn On/Off Layers Widget Use

As per the default, the map layers in the mapping application are all set to be on but are also set to be only shown at certain scale levels. If the user wanted to change which layers were on and off the user, the user would begin with clicking on the Turn On/Off Layers Widget icon button on the Dart Controller Bar (Figure 68). The user would then make sure they are zoomed in on the map to ensure that the layer would appear to be on not be greyed out, as seen in Figure 69. When the layers are at the right zoom level for the layer to turn on the layers in the layer list of the Turn On/Off Widget panel display bolder (Figure 70). If the user, wanted to turn a layer off such as hospitals, the user would click the checkbox to remove the checkmark to turn the layer off (Figure 71). To turn the layer back, the user would click the checkbox again to bring the checkmark back and the layer back (Figure 72). In order to close the Turn On/Off Layers Widget. The user would click the black "x" button the top right of the widget panel (Figure 73).

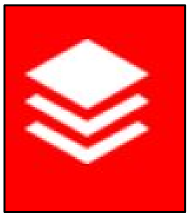


Figure 68. Turn On/Off Layers Widget Button

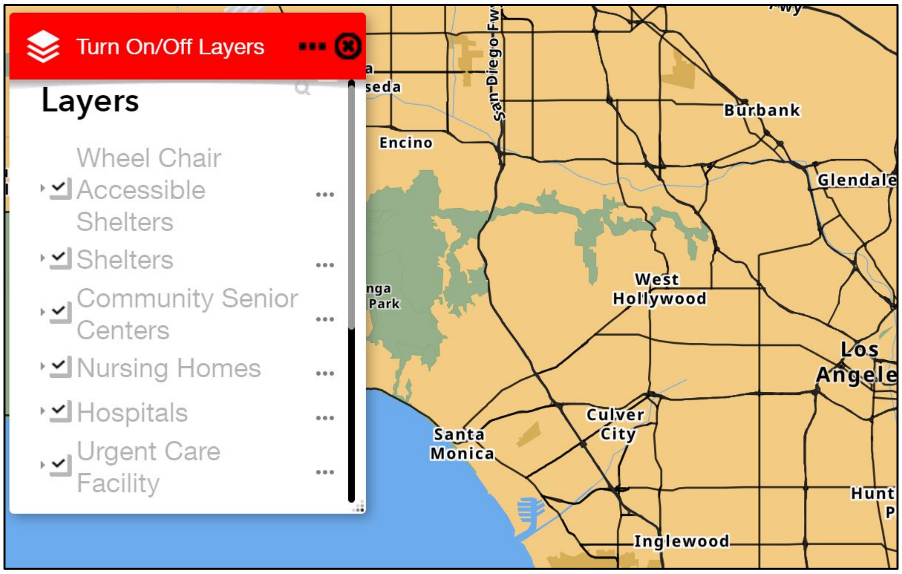


Figure 69. Layers Greyed Out

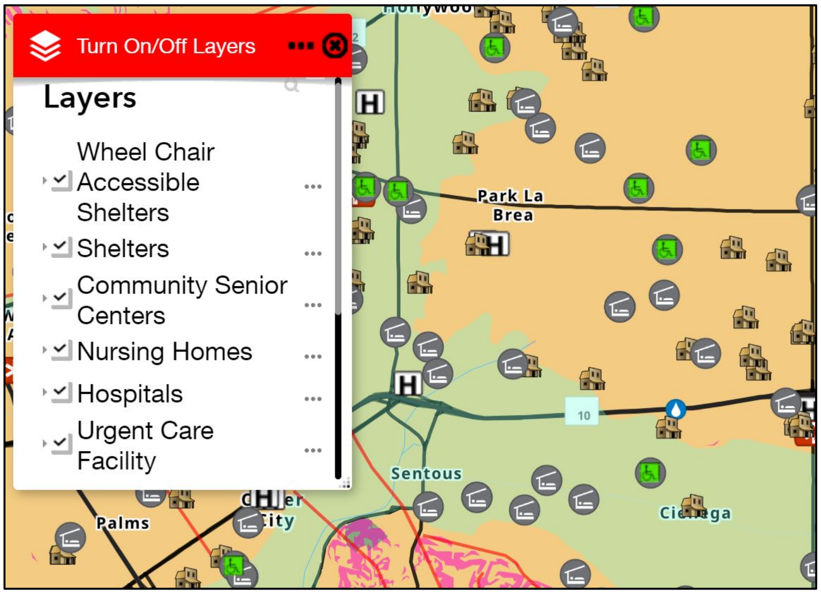
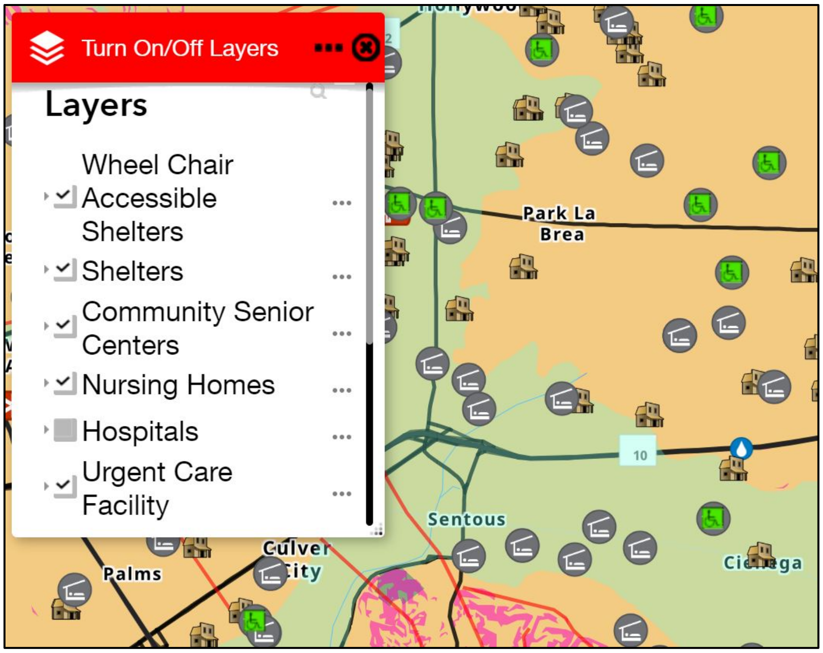
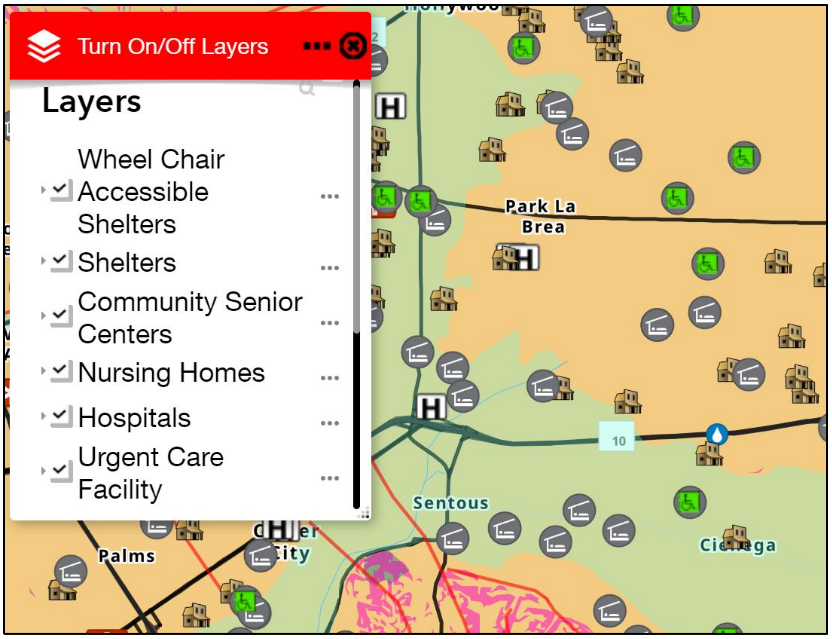


Figure 70. Layers Displayed Bold



☑ Wheel Chair Accessible Shelters
☑ Shelters
☑ Community Senior Centers
☑ Nursing Homes
□ Hospitals
☑ Urgent Care Facility

Figure 71. Hospitals Off



☑ Wheel Chair Accessible Shelters
☑ Shelters
☑ Community Senior Centers
☑ Nursing Homes
☑ Hospitals
☑ Urgent Care Facility

Figure 72. Hospitals On

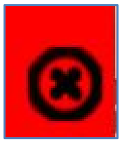


Figure 73. Close Button

6.1.4. Identify Layers with the Legend and Pop-up Box

If a user wanted to identify a layer and information about map layer, the user would simply find the layer by looking in the map and opening the Legend Widget by hitting the button icon on the Dart Controller Bar (Figure 74) to make sure they are looking at the correct feature they wish to identify. After the user compares the map to the legend to make sure they have the correct feature to click (Figure 75), the user would click on the feature to bring up the pop-up window that identifies information about that feature (Figure 76).

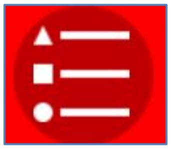


Figure 74. Legend Widget Button

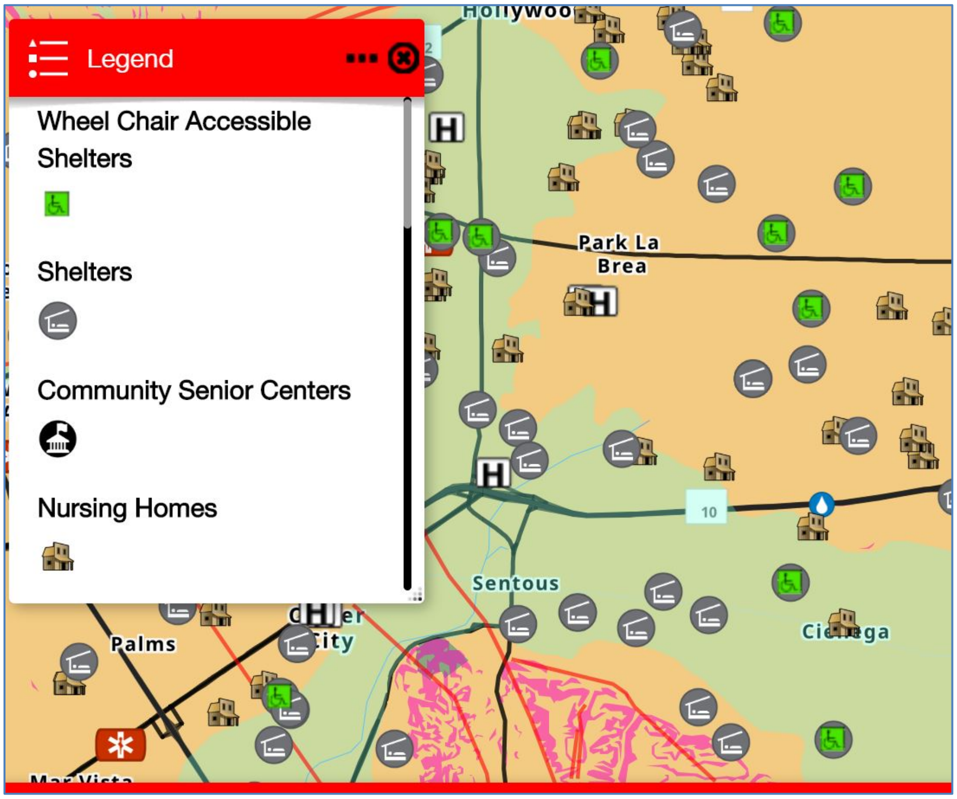
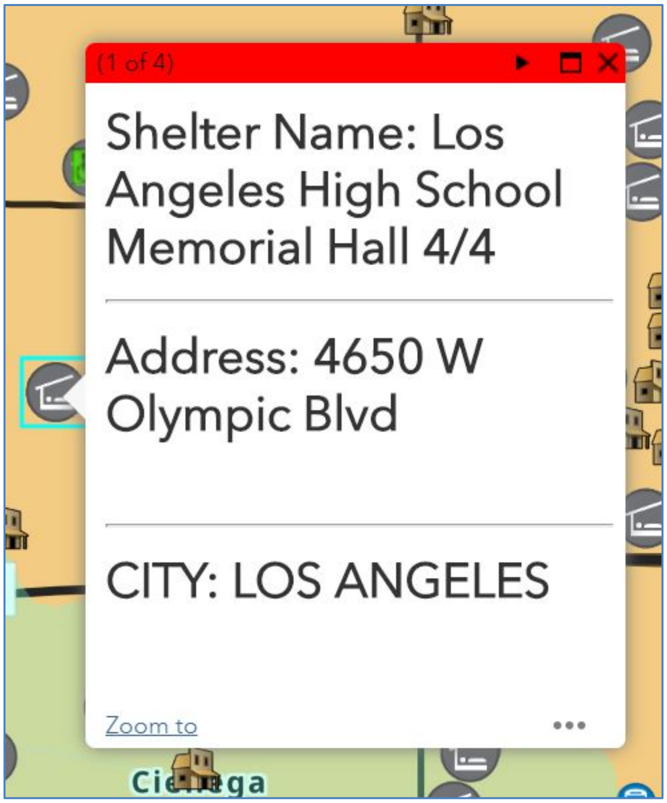


Figure 75. Legend and Map Comparison



(1 of 4)

Shelter Name: Los Angeles High School Memorial Hall 4/4

Address: 4650 W Olympic Blvd

CITY: LOS ANGELES

Figure 76. Pop-up Activated

6.1.5. Using the Print Widget

If a user wanted to use the Print Widget in order to get an electronic print of the map, the user would click on the Print Widget button icon (Figure 77) on the Dart Controller Bar in order to open the Print Widget panel. The user would want to make sure they have the map view set to what they want to print and have the appropriate layers turned on or off that they want in the printout. Users would then set their Print Layout, Map Title, and Format. Once the user has set the parameters for the print, the user would hit the print button (Figure 78). The user can then open the print file once it has completed creating the map print (Figure 79).

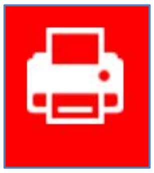
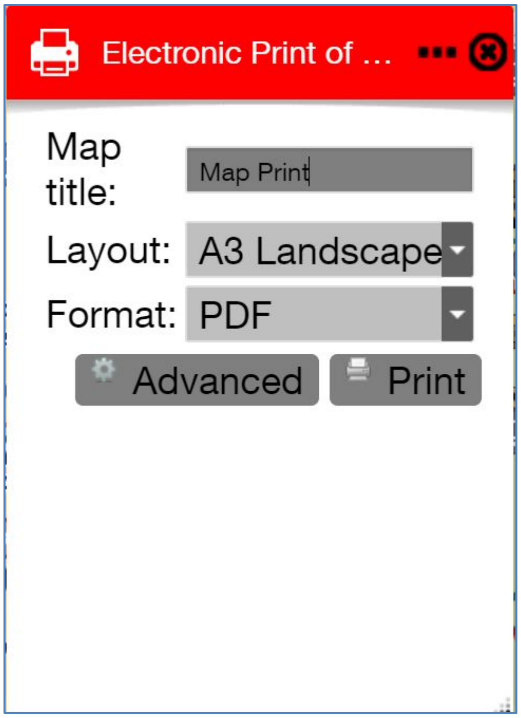


Figure 77. Print Widget Button Icon



Map title: Map Print

Layout: A3 Landscape

Format: PDF

Figure 78. Setting Print Parameters

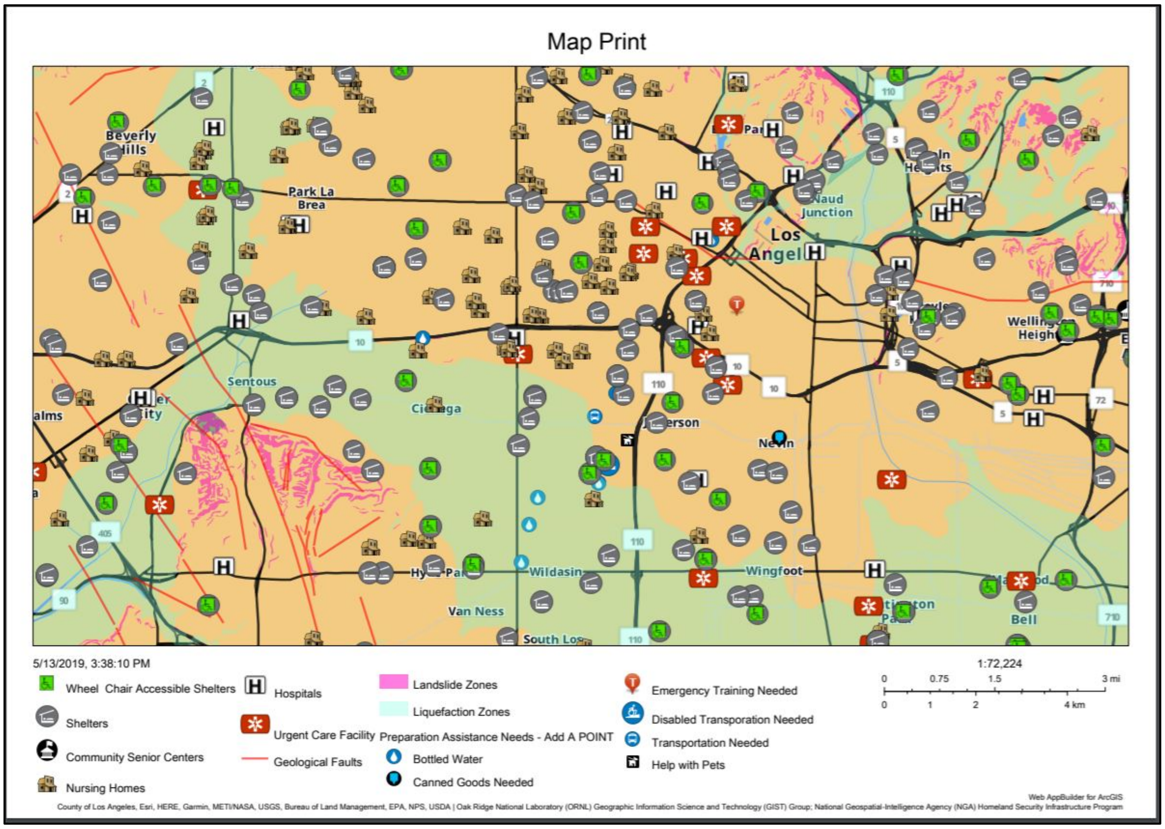
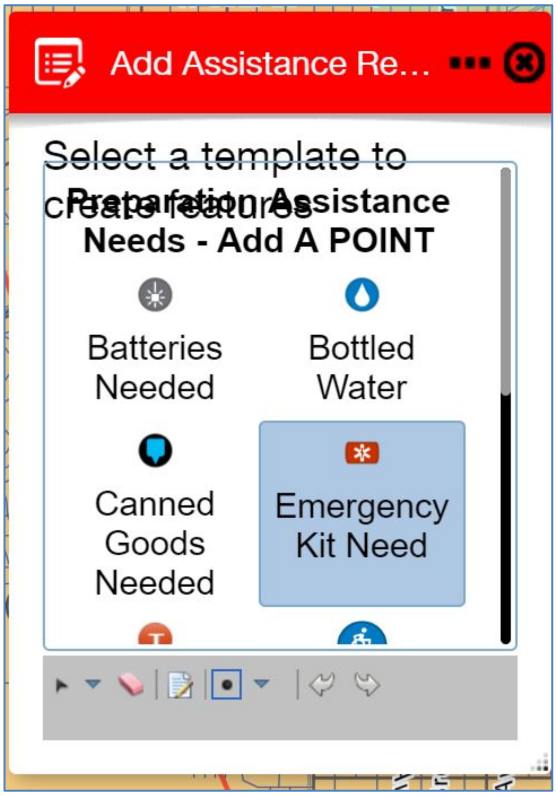

Map Print
Beverly Hills
Park La Brea
Los Angeles
Naud Junction
Wellington Heights
Sentous
Cienega
Jefferson
Nevin
Wildasin
Wingfoot
Van Ness
South Los
Bell
5/13/2019, 3:38:10 PM
1:72,224
0 0.75 1.5 3 mi
0 1 2 4 km
Wheel Chair Accessible Shelters
Shelters
Community Senior Centers
Nursing Homes
Hospitals
Urgent Care Facility
Geological Faults
Landslide Zones
Liquefaction Zones
Preparation Assistance Needs - Add A POINT
Bottled Water
Canned Goods Needed
Emergency Training Needed
Disabled Transporation Needed
Transportation Needed
Help with Pets
Web AppBuilder for ArcGIS
County of Los Angeles, Esri, HERE, Garmin, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA | Oak Ridge National Laboratory (ORNL) Geographic Information Science and Technology (GIST) Group; National Geospatial-Intelligence Agency (NGA) Homeland Security Infrastructure Program

Figure 79. Map Print Output

6.1.6. Using the Add Assistance Request Point Widget

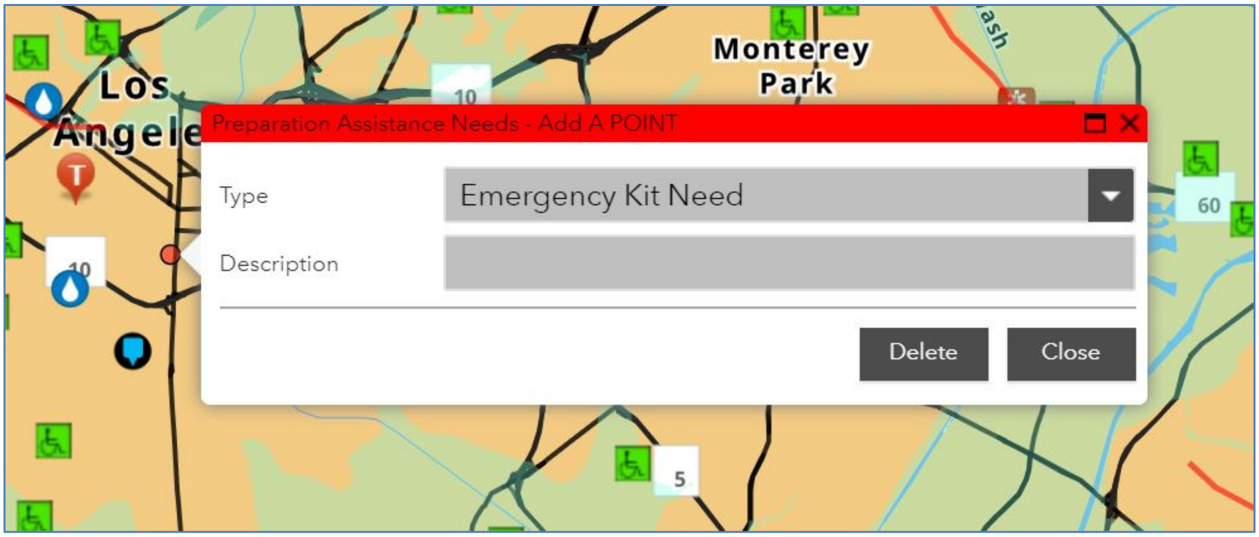
If a user wanted to add an assistance request point to the map, the user would begin by zooming to their location using the Location Widget or using the Zoom Slider Widget and panning with their finger or mouse depending on the device to move to a desired location. Once the user is set to a location, the user would click on the Add Assistance Request Point Widget button icon Figure 80). Then once the user opens the widget, the user would select a type of assistance request that they would like to put on the map (Figure 81). Once the type is selected, the user places the point on the map and fills out the description (Figure 82).

Figure 80 Add Assistance Request Point Widget Button Icon



Select a template to create features

Figure 81. Add Assistance Request Point Picker



Preparation Assistance Needs - Add A POINT

Type: Emergency Kit Need

Description

Delete Close

Figure 82. Adding Assistance Request Point to the Map

6.1.7. Using Nearest Shelters Widget

In order to use the Nearest Shelters Widget to find the closest wheelchair accessible shelters or all shelters, the user would begin by clicking on the Nearest Shelters Widget Button Icon (Figure 83). Then the user could either use the search bar to search for an address (Figure 84), or use the location picker. In order to use the location picker, the user would have to click on the black balloon and turn the balloon green (Figure 85). Once the balloon is green, the user can select a location on the map to search shelters given a radius. The radius can be set from one to five miles. The widget panel will then display a list of results of the number of each feature found (Figure 86). When the user clicks on the name of the map layer feature, the panel displays the locations and their distances (Figure 87). The example would work in the same manner for the Nearest Emergency Services Widget.

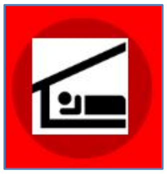
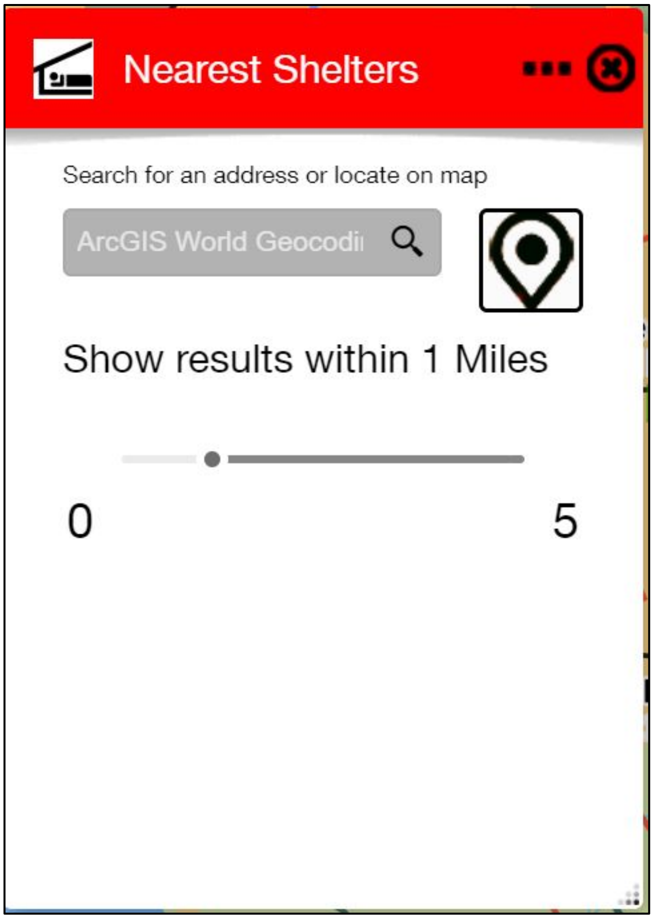


Figure 83. Nearest Shelters Button Icon



Nearest Shelters

Search for an address or locate on map

Show results within 1 Miles

Figure 84. Nearest Shelters Widget Panel

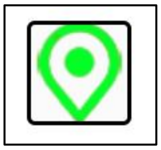
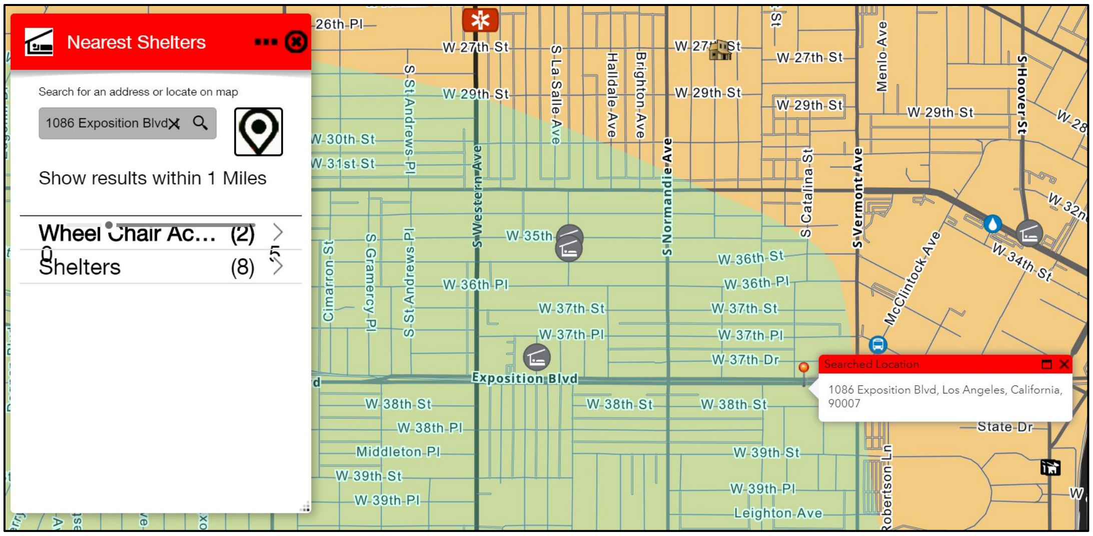


Figure 85. Activating Map Picker


Nearest Shelters

Search for an address or locate on map

1086 Exposition Blvd

Show results within 1 Miles

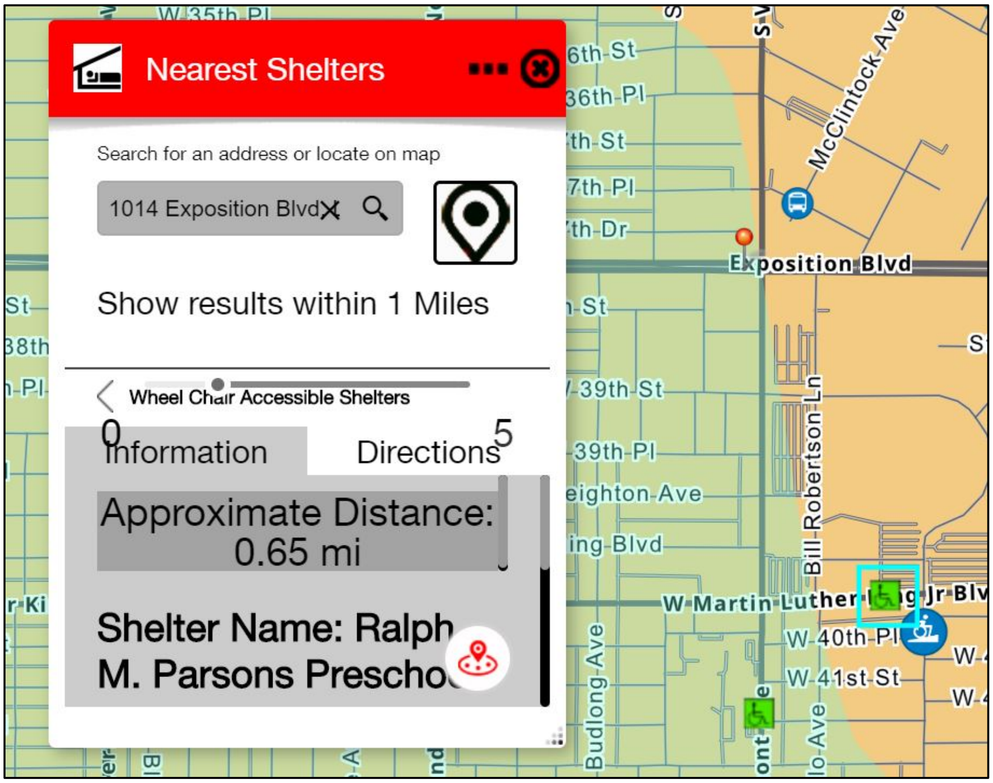
Wheel Chair Ac... (2)

Shelters (8)

Searched Location

1086 Exposition Blvd, Los Angeles, California, 90007

Figure 86. Nearest Shelters Map Pick


Nearest Shelters

Search for an address or locate on map

1014 Exposition Blvd

Show results within 1 Miles

Wheel Chair Accessible Shelters

Information | Directions

Approximate Distance: 0.65 mi

Shelter Name: Ralph M. Parsons Prescho

Figure 87. Nearest Shelter

6.2. Training Materials

The author developed training materials in order to help older adult users with the application. The author wrote a document explaining the functionality with screenshots of the application. The document began with general information about the document and the design the intended purpose. The document then noted the EQ App web address with a live link that could be clicked on to take the user to the application. The document then gave a view with screens of the overall application on laptop device and a mobile phone device along with descriptions of the buttons seen and the map. The next section of the document described the different application parts, such as controller bar and the widget buttons on the controller bar. The subsections thoroughly discussed each widget and what the purpose was of the widget and how to use it. After completion, the document was loaded to the web server at the following location: https://gis-web.usc.edu/beveritt/Documents/EQPrepAppHelpDocument.pdf (Available May 31, 2019) The document was then linked in the Application Information Widget Panel. The document can be seen in Appendix A. The developer also produced a demo video explaining how to use the application and placed the video on screencast at the following location. https://www.screencast.com/t/nqcy0iVjL. The link was posted in the Application Information Widget so that users could click on the link for help.

6.3. Application Test and Results

This section describes the application test and the results of the focus group that tested the application. Section 5.3.1 details how the application was tested. Section 5.3.2 will list out the user comments noted during the application. Section 5.3.3 will discuss the design of the survey. Section 5.3.4 will discuss the results of the survey.

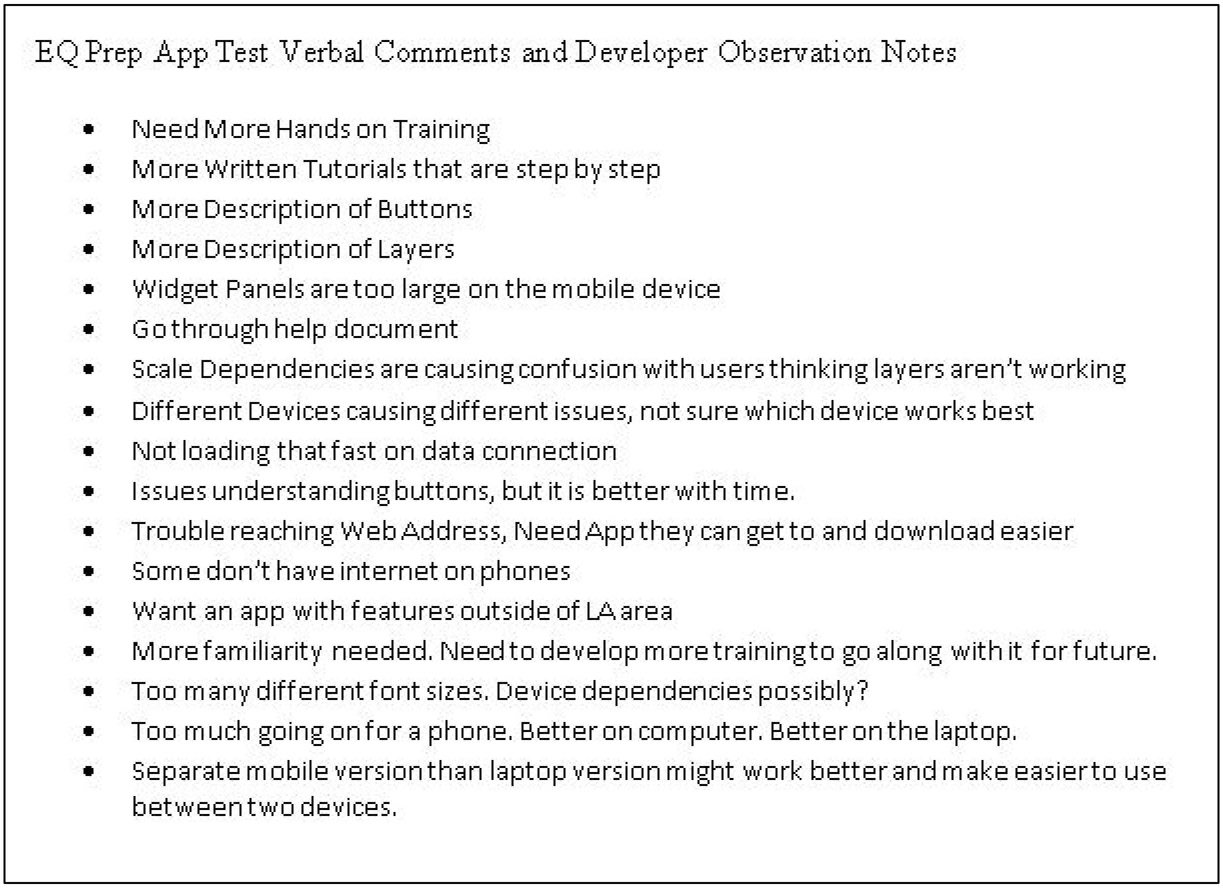
6.3.1. Application Testing

A small focus group was assembled through the USC School of Gerontology with the help of the School of Gerontology staff in order to test the document. An instructions document and demo video were created to show the application functionality, and a short survey was drafted for participants to share their opinions on the application content and functionality.

The focus group was held on March 8, 2019, at 12pm PST at the USC School of Gerontology. It was proctored by two faculty advisors from the USC SSI. The student developer attended via BlueJeans and provided an instructional walkthrough of the application. Attendees of the focus group were then asked to review the help document and to test out the application via their smartphones and laptops provided by the SSI. Surveys were handed out after the test. As the faculty proctors answered questions and provided help to attendees, the student developer watched via BlueJeans and took notes.

6.3.2. Comments and Observations

During the course of the application test, the developer wrote down comments from the focus group of users and the assisting advisors. The developer also wrote down observations based on comments while the focus group was trying to use the application after they were given the help document and demo. Comments varied from different testers in regards to application functionality, design, and usefulness. Below in Figure 88 is a bullet list of user, developer, and advisor comments and observations that were recorded for results. Chapter 6 will go into a general discussion of the comments and observation notes.



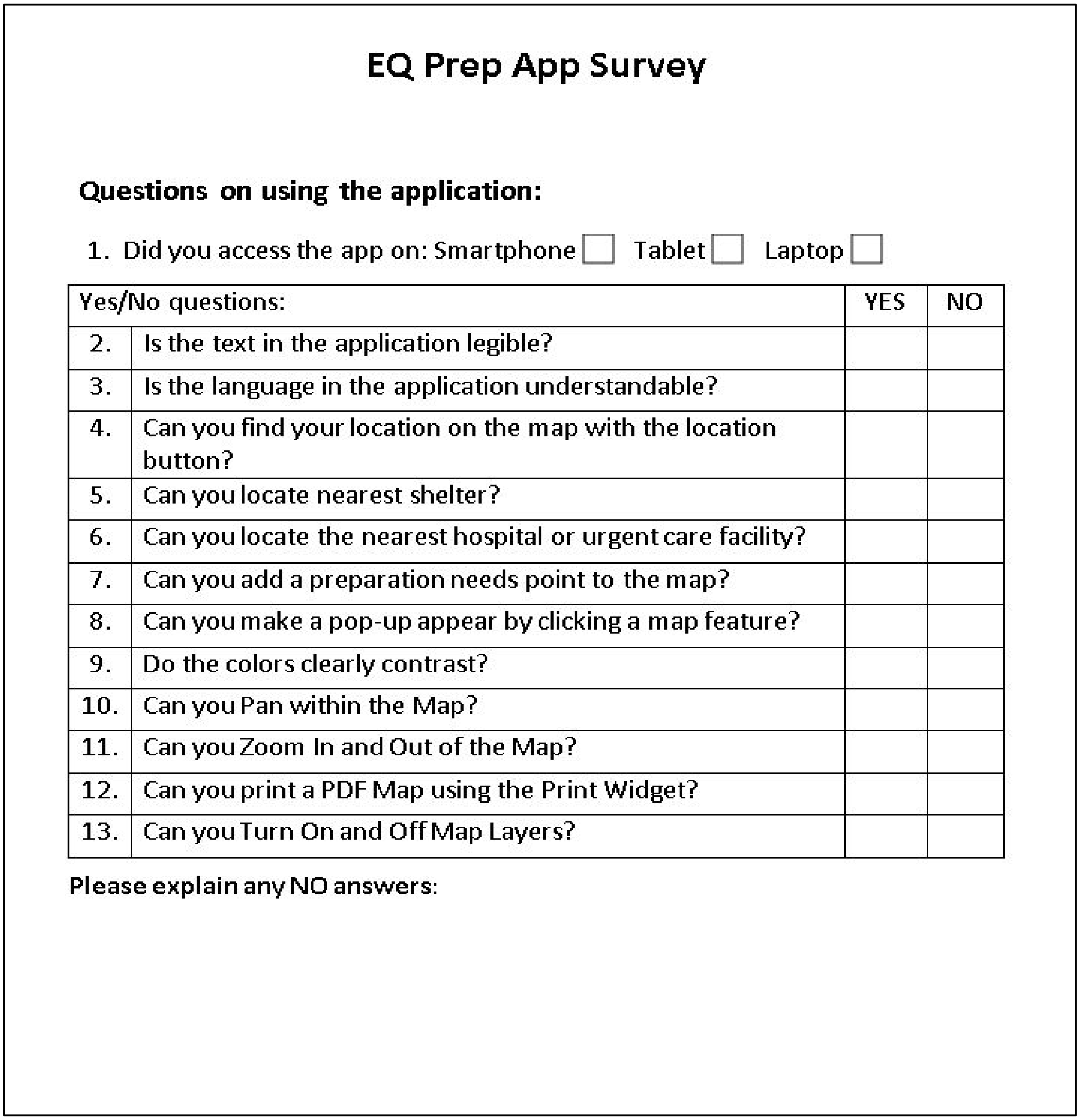
EQ Prep App Test Verbal Comments and Developer Observation Notes

- Need More Hands on Training
- More Written Tutorials that are step by step
- More Description of Buttons
- More Description of Layers
- Widget Panels are too large on the mobile device
- Go through help document
- Scale Dependencies are causing confusion with users thinking layers aren't working
- Different Devices causing different issues, not sure which device works best
- Not loading that fast on data connection
- Issues understanding buttons, but it is better with time.
- Trouble reaching Web Address, Need App they can get to and download easier
- Some don't have internet on phones
- Want an app with features outside of LA area
- More familiarity needed. Need to develop more training to go along with it for future.
- Too many different font sizes. Device dependencies possibly?
- Too much going on for a phone. Better on computer. Better on the laptop.
- Separate mobile version than laptop version might work better and make easier to use between two devices.

Figure 88. Verbal Comments and Observation Notes

6.3.3. Survey Design

The survey contained three different sections. The first section focused on application functionality. The first section of questions asked if the functionality is useful and if they could make the application function for that specific purpose. The second section was based on application design of the map and map features. The second set of questions asked if the map layer was useful information to have in the application and if they were able to identify the map layers and differentiate the map colors. The design process of questions features simple yes or no questions with a place to put the reasons why a test picked no. The third section of questions was based on the overall application and were essay type questions that required the user to write the answer in for those three questions. This third section requested the testers' opinions. Figure 89, Figure 90, and Figure 91 show the pages of the survey that was given out to tests in the focus group. Section 5.3.3 will discuss the results of the survey. Conclusions reached from the application test survey will be discussed in chapter 6.



EQ Prep App Survey

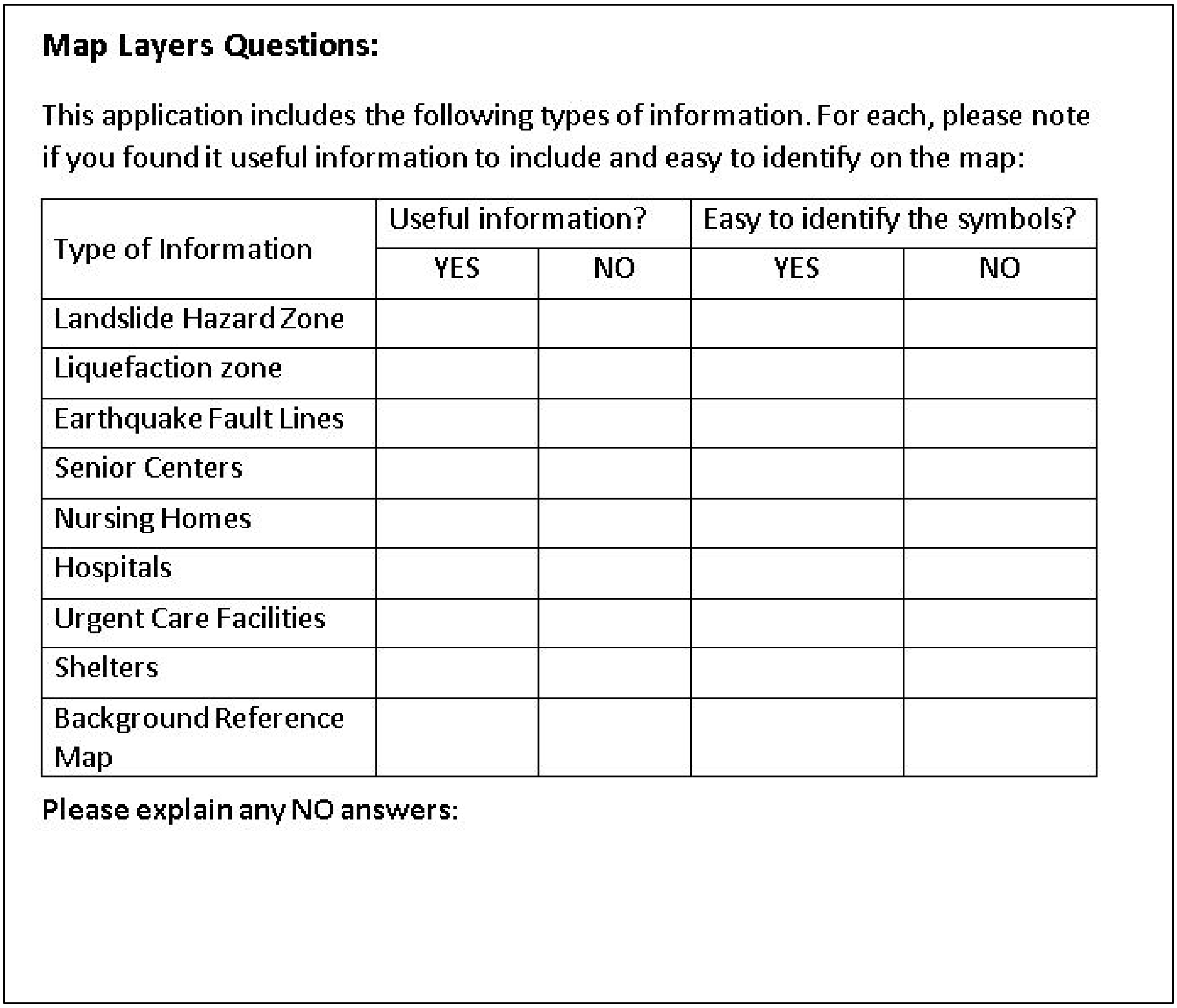
Questions on using the application:

1. Did you access the app on: Smartphone □ Tablet □ Laptop □

Yes/No questions:		YES	NO
2.	Is the text in the application legible?		
3.	Is the language in the application understandable?		
4.	Can you find your location on the map with the location button?		
5.	Can you locate nearest shelter?		
6.	Can you locate the nearest hospital or urgent care facility?		
7.	Can you add a preparation needs point to the map?		
8.	Can you make a pop-up appear by clicking a map feature?		
9.	Do the colors clearly contrast?		
10.	Can you Pan within the Map?		
11.	Can you Zoom In and Out of the Map?		
12.	Can you print a PDF Map using the Print Widget?		
13.	Can you Turn On and Off Map Layers?		

Please explain any NO answers:

Figure 89. Survey Questions Section 1



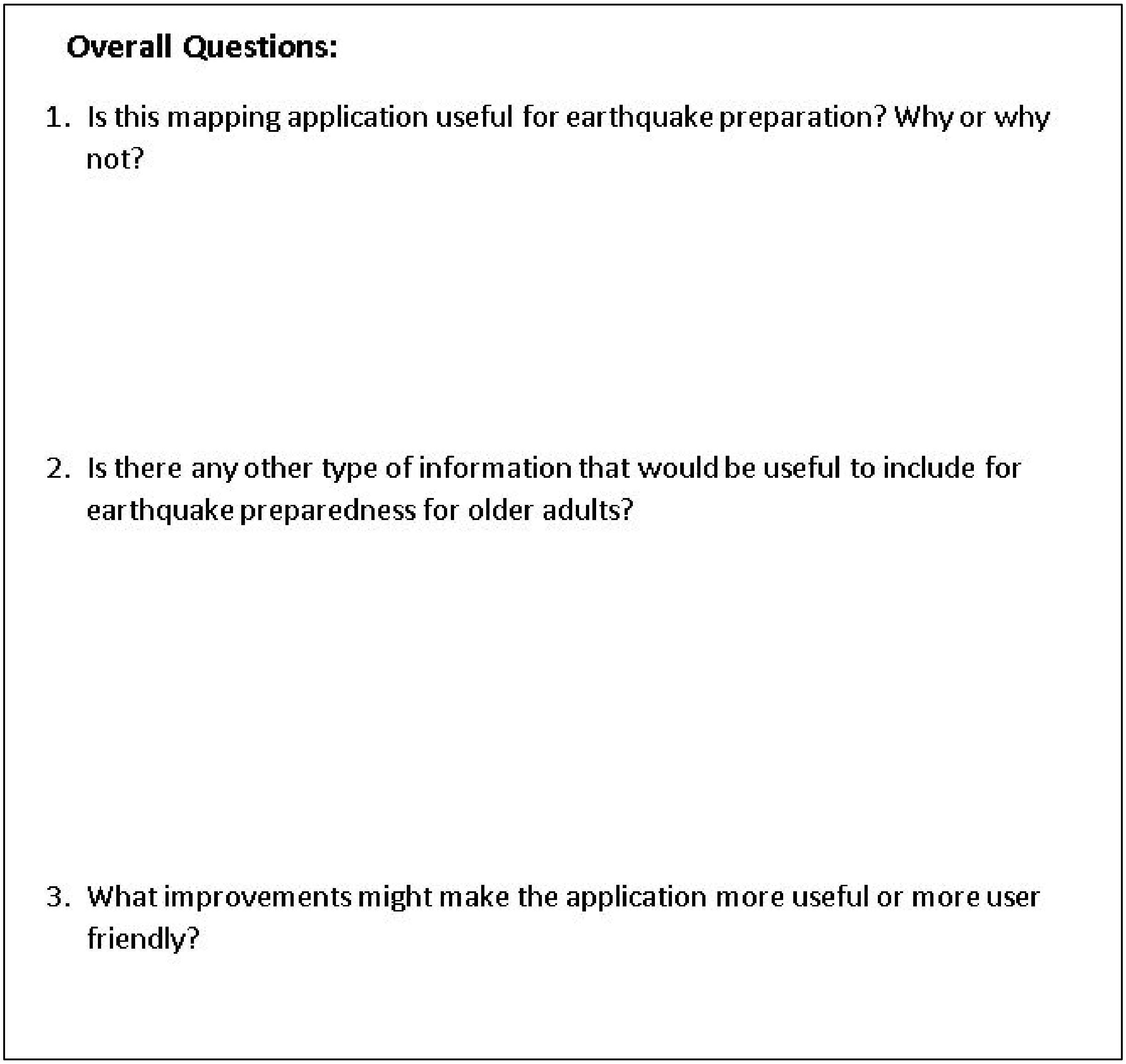
Map Layers Questions:

This application includes the following types of information. For each, please note if you found it useful information to include and easy to identify on the map:

Type of Information	Useful information?		Easy to identify the symbols?	
	YES	NO	YES	NO
Landslide Hazard Zone				
Liquefaction zone				
Earthquake Fault Lines				
Senior Centers				
Nursing Homes				
Hospitals				
Urgent Care Facilities				
Shelters				
Background Reference Map				

Please explain any NO answers:

Figure 90. Survey Questions Section 2



Overall Questions:

1. Is this mapping application useful for earthquake preparation? Why or why not?

2. Is there any other type of information that would be useful to include for earthquake preparedness for older adults?

3. What improvements might make the application more useful or more user friendly?

Figure 91. Survey Questions Section 3

6.3.4. Survey Responses

This section discusses the responses of the survey to the application test with the focus group of users held on March 8, 2019. Section 5.3.3.1 discusses overall response to the application. Section 5.3.3.2 discusses the responses to section 1 of the survey. Section 5.3.3.3 discusses the responses to section 2 of the survey. Section 5.3.3.4 discusses the responses to section 3 of the survey.

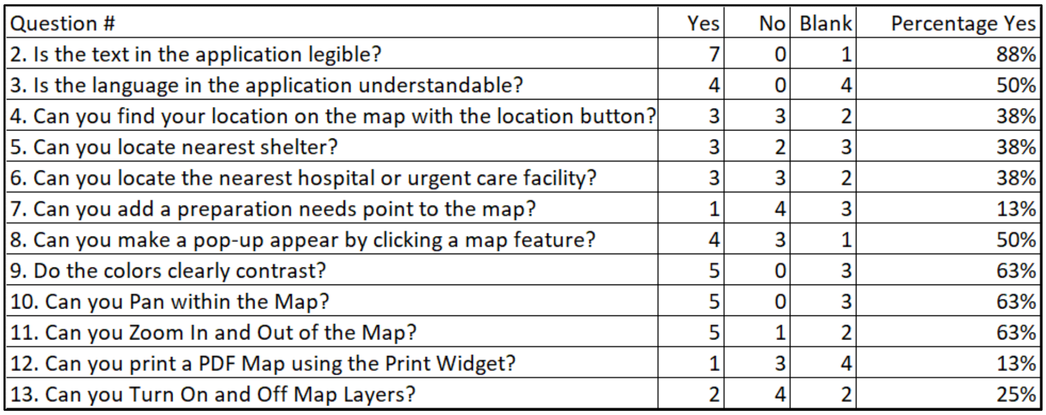
6.3.4.1. Response to the Survey Overall

A total of eight older adults took part in the focus group, and all but one completed the survey. In regards to the question of the type of device used, six of the eight responded to the question. Of those six, 100% of those testers used a smartphone to do the initial test of the application although laptops were available in the room and later used by some. For the first section of questions, seven of the eight testers responded with answers. For the second section of questions, seven of the eight testers answered the questions; however, one of the eight was inclusive what was chosen because the markings were not clearly in the box. Those answers for section two were thrown out of the results. For the questions in section three, only six of the eight responded to the overall app survey questions. The next section discusses the answers to section one questions with more detail.

6.3.4.2. Responses to Section One

Responses to section one included the survey that was not responded to. The developer included a blank answer to results as other tests left certain questions blank also. The table below shows the number of yes, no, and blank responses and percentages of yes answers for each. The highest percentage for section one was for question one at 88%. Questions nine through twelve were the second highest all at 63% for yes answers. Questions seven and thirteen had the lowest response of yes at 13%. For the comments as to the reasons many chose no or left blank, responses included that some users could not get the map layers to appear or the application to appear on their device. A few users also responded that with more time training and testing that they could answer yes.

Table 2 Survey Section One Question Responses

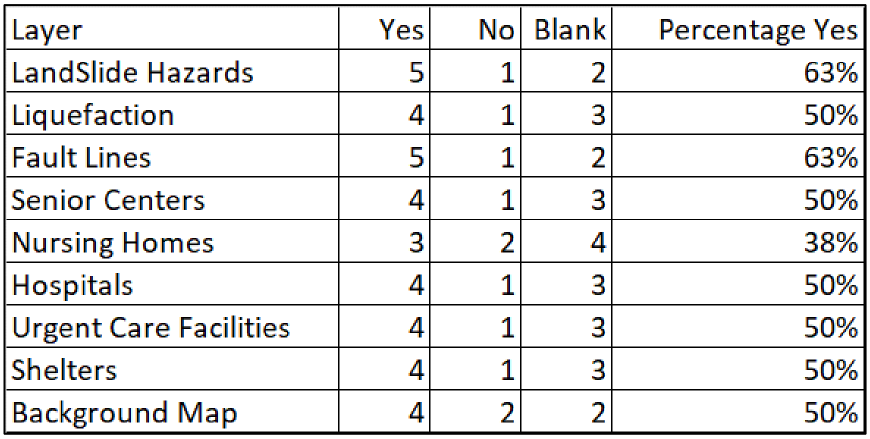


Question #	Yes	No	Blank	Percentage Yes
2. Is the text in the application legible?	7	0	1	88%
3. Is the language in the application understandable?	4	0	4	50%
4. Can you find your location on the map with the location button?	3	3	2	38%
5. Can you locate nearest shelter?	3	2	3	38%
6. Can you locate the nearest hospital or urgent care facility?	3	3	2	38%
7. Can you add a preparation needs point to the map?	1	4	3	13%
8. Can you make a pop-up appear by clicking a map feature?	4	3	1	50%
9. Do the colors clearly contrast?	5	0	3	63%
10. Can you Pan within the Map?	5	0	3	63%
11. Can you Zoom In and Out of the Map?	5	1	2	63%
12. Can you print a PDF Map using the Print Widget?	1	3	4	13%
13. Can you Turn On and Off Map Layers?	2	4	2	25%

6.3.5. Section Two

Section two question responses were related to map layers. Testers were asked if the information was useful or not and if they were able to identify the symbols or not on the map. Responses vary from yes, no, and blank. All eight of the surveyors responded in some fashion to the questions in section two of the survey. One tester responded to all questions with no, with the comment that they were not able to access. One other tester left questions blank for section two. Table 3 below shows the responses to section two of the survey for the useful section of the survey. Table 4 below shows the responses to section two of the survey for the identifiable section.

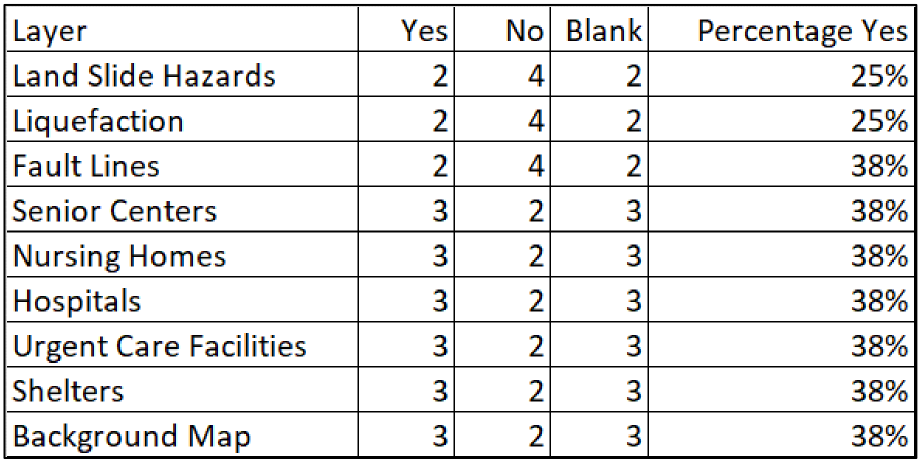
Table 3. Section Two Layer Usefulness Results



Layer	Yes	No	Blank	Percentage Yes
LandSlide Hazards	5	1	2	63%
Liquefaction	4	1	3	50%
Fault Lines	5	1	2	63%
Senior Centers	4	1	3	50%
Nursing Homes	3	2	4	38%
Hospitals	4	1	3	50%
Urgent Care Facilities	4	1	3	50%
Shelters	4	1	3	50%
Background Map	4	2	2	50%

For application usefulness, only nursing homes were given below a 50% score of yes as a useful map layer. Those in the focus group only gave nursing homes 38% for usefulness in the mapping application. The highest yes responses were for landslide layers and fault lines at 63% useful. All other layers were seen as 50% useful. However, a few in the test group did not respond. Also, one responder's results for section two were counted as blank as the marks could not be read. The results could have been higher if the questions were answered or been legible; however, the answers could have also been no for those questions.

Table 4. Section Two Layer Identifiable Question Responses



Layer	Yes	No	Blank	Percentage Yes
Land Slide Hazards	2	4	2	25%
Liquefaction	2	4	2	25%
Fault Lines	2	4	2	38%
Senior Centers	3	2	3	38%
Nursing Homes	3	2	3	38%
Hospitals	3	2	3	38%
Urgent Care Facilities	3	2	3	38%
Shelters	3	2	3	38%
Background Map	3	2	3	38%

For being able to identify layers and map symbols, the users responded with much lower percentages. The highest percentage was 38% for seven of the layers listed. Only 25% of the survey responders said that they were able to identify the landslide hazards and fault lines. According to comments listed on the survey as to why the survey responders checked no or left blank, they could not get the layers to come up in the application, and the layers needed to be labeled better for what each layer was. Another surveyor commented on the survey that they needed more explanation of what the layers actually were.

6.3.6. Survey Section Three

Survey section three responses provided an opportunity for users to answer questions in a few words or sentences. For question one, “Is this mapping application useful for earthquake preparation? Why or Why not?”, those in the focus group that responded to the survey responded with answers like: “The idea is great!”, “Knowing where you live in reference to more dangerous areas let you know what you have to prepare for,” “need more time to evaluate,” “no,” “yes,” and “very, useful. It allows you to find nearby help in an emergency. I was easily able to identify my house in an emergency.”

For question two, the survey asked if there were any other map features that needed to be added to the application. Only four responses to this question were recorded. The responses were as follows: no, shelters for large animals such as horses, markets, and food. Food and markets could be grouped together; however, they are left separate because more can be bought at markets than just food.

For questions three, the users were asked what could be done to improve the application. The responders to the survey commented that more time to practice the application would be helpful along with step-by-step guides. Another responder commented that the site was not very good for the mobile phone because their phone kept losing site access. The same responder also commented that the site was harder to navigate on the phone. Another responder comment that they could provide more information if they were able to get the application to work better.

Chapter 7 Conclusions

This chapter looks back on the project as a whole, discussing issues that arose during the application development and future research and development possibilities. Section 7.1 describes issues found with data, software, and methods. Section 7.2 discusses the issues found with the application results and the possible final application considerations to fix issues. Section 7.4 discusses future research that needs to be done. Section 7.5 gives the final conclusion

7.1. Issues with Data and Software

This section describes issues with the data, software, and methods encountered during this project. Section 7.2.1 summarizes challenges in working with the data. Section 7.2.2 details issues with the software. Section 7.2.3 will discuss issues with the methods.

7.1.1. Data Issues

The main issues with the data used in the application were based on integrity of using data from other resources. One of the users in the application test commented that one of the locations of a hospital is the location of a now-closed hospital. The data from for the hospitals comes from a Department of Homeland Security (DHS) server. The developer is unsure how often the data is updated; however, the DHS maintains this infrastructure dataset and is the authoritative dataset. This issue with the dataset brings attention to the overall data integrity of using data from other sources that could not be up to date. When preparing for emergencies and knowing locations of places, knowing the correct location is very important, and data that is incorrect could lead to people preparing to go to the wrong place.

Another issue with the data was based on the integrity of the system from which the data is sourced. The FEMA Shelter server that houses and servers out the FEMA National Shelter

System web service data proved to be very unreliable throughout the development process. The shelter server would be offline during times of development, which caused the application and map to lose the data. The data had to be extracted and rehosted in a more reliable place, on the USC SSI AGOL with a timestamp. Having to extract the data and rehost makes the information only reliable for that timestamp because it is no longer connected to the authoritative dataset being updated by the agency that oversees the program. The data was only good for testing. In the future, issues need to be worked out with the FEMA Shelter web service.

7.1.2. Software Issues

One of the main issues experienced was with the chosen software platform of Esri ArcGIS API for JavaScript and the Web AppBuilder framwork. Although the Esri software was efficient in bring the map together in the web environment and allowing for redeployed customized code, the API had a few limitations that proved to either be difficult to address, or the code could not be accessed. The API works with web GIS; however, the API is not readily customizable for multiple devices, such as to run on an iPad and a mobile phone, for the same application. Changes to the code that made the widget buttons larger and the widget panels larger caused issues with the application on the smaller screen mobile devices. Because those items were enlarged based on a laptop device with a larger screen, the widgets buttons on the Controller Bar were too large and would not appear on screen. The API did not adjust the controller bar between devices so that all buttons were display. The widget panels would also cover up the whole screen on smaller mobile devices. The API and application code did not adjust for the smaller screens. The buttons needed to be larger and the text in the panels needed to be larger; however, the code did not offer more a smaller screen friendly version of the application that when opened, buttons and text were still large but not covering up the entire screen and were still easily navigable.

The Web AppBuilder framework caused issues when certain code could not be updated because the code resided on an Esri server that could not be touched. It was evident that Esri did not want that code being edited; however, that code would have helped in making customizations to make the application more user friendly. One example of the code not being edited because of this limitation is with the space in the editor widget.

The Esri API use of sprite images for several icons impeded customization. A sprite image contain several images per file. When the developer would try to enlarge a button icon, more of the images would appear. The sprite images need to be changed to allow single icon images per image file. This would allow for more customization.

The Esri API code was also not very well documented as to what code was in which folder and what items were controlled by what code and file. The developer had to use inspection tools in the browser to find certain elements to customize. If there was more documentation as to where items were located in the code and folder structure, the developer could have made changes to the code more easily.

Another issue with the software code was the inability to change the hover text when an object is hovered over using the mouse. The developer even asked on Esri forums, and the consensus was that the code couldn't be edited. Limiting this ability didn't allow the developer to fully customize the information description of the buttons.

7.2. Application Results Discussion

Chapter 5 described the results of the development and of the focus group's test of the EQ Prep App. This section of chapter 7 summarizes key issues identified in the focus group and how those issues can be addressed going forward. Section 7.2.1 discusses the application accessibility issues and ways to address the issues. Section 7.2.2 details the need for additional application training for users. Section 7.2.3 describes the issues with application terminology and ways to address the issue. Section 7.2.4 analyzes the issues with text design. Section 7.2.5 examines issues with map layer design. Section 7.2.6 looks at application button issues. Section 7.2.7 discusses issues with device design.

7.2.1. Application Accessibility

Testers had difficulty reaching the application by way of the provided URL. Some testers responded that they did not have internet on their phone. Some users were unaware of what the browser was or if they had one. Some users had issues typing the long string into the browser. Based on these issues, the developer believes an easier way to access the application needs to be designed. Using a QR code or native application that could be downloaded to the device might prove easier to use to get to for the older adult users. If the design is to be more user-friendly for older adults, the way the users get to the application must be easier to access than the URL.

7.2.2. Application Training

A good portion of the focus group needed help operating the application. The help document developed and live demonstration of the application were not enough to help the users with the application. The comments from the focus group suggested that they wanted a step by step tutorial and training exercises to learn how to use the application. The focus group also wanted more personal assistance with the application and want more help while using the application. In order to meet the needs of the intended audience and users of the application, a step by step document and training classes need to be developed in order to help the application be more successful with older adults. Assistants should also be trained on the application in order to help and train the older adults with the application. Training documents also need to be included to help with map terminology describe different map features such as liquefaction. The developer believes that more training for the application could lead to a more successful deployment of the application and a more successful application test response.

7.2.3. Application and Map Terminology Issues

Based on a few of the comments and survey responses relating to the description of the application features and the map, there appeared to be an issue with the terminology of the application. The testers mentioned that they did not know what some of the application features were and did not understand some of the names of the layers in the table of contents. They commented that a better description of the application buttons and may layers would be useful to understand what buttons and layers were. Several testers also did not answer favorably to being able to identify map features in the survey. Future considerations for the application should include labels for features describing better what buttons do. Using labels for buttons could help users identify buttons, and having a feature description or glossary could help explain terminology. The developer should also consider testing more common terminology for the map layers with those in the older adult community as well as adding a glossary of terms that explains map features and application features.

7.2.4. Text Size Issues

Although all testers recorded that they could read the text, one of the advisors noted that differences in text size in the application could be causing issues with the testers and that the text sizes should be more standardized throughout the application. The application text sizes come from many different CSS files within the application and are many different sizes in the original code provided. The application development process only considered increasing the font sizes, but the developer did not consider standardizing the fonts across the application. The method of increasing the font sizes was only meant to test changing the code in the API and to see if the changes to size were readable. The pixel sizes were to at least larger than 14 pixels and the larger, the better as long as the text could fit within the space on the screen and be easily readable.

The developer could consider standardizing the text in the code within the API more so that the text sizes would not be several different sizes. The customized application should be also be tested against a base application with no code changes to text sizes in order to get a better result if the users could read the text in a non-customized application. Testing the customized text against the non-customized text would show which customized text was more necessary to change.

7.2.5. Map Layer Issues

This section discusses issues found with the map layers chosen for the application and the design of the layer symbology. Many of map layers were added based on developer experience with emergency applications with commonly used features, past earthquake applications, and interviews with the Department of Aging LA, the EOC in LA, and the School of Gerontology. The results of the application test gave a clearer picture of what older adults would users in the audience would like to see in the application.

The results showed that certain map layers should either be combined or removed. For the earthquake-related, only fault lines and landslide zones were seen as useful by the testers. The liquefaction layers were not seen as useful by the testers. Some of the users verbally mentioned that they did not understand what a liquefaction zone was. Based on those comments, the application needs to either clear out jargon terms or better describe them as mentioned in the terminology issues section. The liquefaction layers could also just be deleted in future applications or combined in with landslides hazards as an overall earthquake hazards layer to further simply that there are earthquake hazards but not break down the different types. Doing this may help clear up the issue with liquefaction. Based on other responses to the survey to other layers and what layers should be added, the developer believes that the nursing homes should be removed from the application and that places for food should be added along with animal shelters for larger animals.

As far as being able to identify the earthquake features, those all scored very poorly, which was surprising as much attention was given to the layers and how they were identified. The liquefaction and landslide zones were both polygon layers set with 40 percent transparency, so the layers may have been hard to see on the map if displayed together due to overlap. Users may also not have seen the layers if they were not zoomed to where the location of the layers were. If the users were not zoomed to an area of where those features were, they wouldn't have seen them. As the layers were also set to be scale dependent, the layers were not seen when the app was opened. The developer believed that to have an effect on how the questions were answered for layer identification. The final application layers should also be set with scales but explained more clearly that the layers are scale dependent. The legend for the map was also closed so the user would have to open it to be able to see the legend and get the corresponding feature for the symbols. So, the application might benefit from having an open docked legend that explains the symbology. Having the open legend would allow the user to see the map and corresponding explanation of the symbols they are seeing. Having a closed widget makes the user have to open the legend widget. The developer believed that possibly there might have been too many layers to interact with to begin with. The application could benefit by further limiting the number of layers.

7.2.6. Button Design Issues

The major issue found with the buttons is that the users had issues with completing the functionality for a few of the widget buttons. The users either didn't understand or didn't get to the widget buttons in time for the testing. The developer believes that based on the results of the test that the application may have had too many buttons for the older adult users to be able to learn and use. The developer believes that having the basic map with the Pan, Home, Zoom, Find Location, and the Find Nearest Shelters would be more of a suitable amount of functionality. The developer believes that based on the results of the test that the Nearest Emergency Services, Turn On/Off Layers, Print, and Add Assistance Request Points widgets should be dropped from the application. The developer believes that layers should be set to be always on, but reduce the number of layers shown instead of giving the ability to turn them on and off. The developer also believes a simple search widget needs to be added so that users can just search for different places in a search bar similar to the functionality in a google map search engine. With these changes, the application may be more successful in tests of button functionality with testers.

7.2.7. Device Design Issues

Many of the issues were in relation use of the device itself rather than the application. The results backed up previous research noted in Chapter 2, that larger screens were better for older adult user design. All of the testers used mobile phones first, and then some tried the laptop version. Most of the users testing mobile device experienced issues. Several of the panels for the widgets would cover up the entire screen on mobile devices, a design limitation. Users commented that they could not see the map on the screen or when going back and forth from the widget panel to the map on the mobile phone device. All widgets buttons on the Controller Bar at the bottom of the application displayed on larger screen devices such as laptop. On smaller screen devices such as a mobile phone, the full bar at the bottom of the screen with all of the widgets was only partially displayed. The user had to scroll through the widgets or swipe over to see the additional widget buttons on the controller bar at the bottom of the application. Other issues with devices were based on functionality; some users had issues with opening popups widget panels. The developer believes that based on the results of the survey and comments made by the mobile phones users, that there was not have enough screen space to see how to open and minimize widgets or to allow the touch screen to function properly. After the users tried the laptop version, the users commented that the laptop version was better because the screen size allowed them to see things better.

Based on the comments and these observations, the developer needs to consider the design of laptop and mobile versions separately. For example, a mobile version should show more clearly on smaller mobile phone devices when designed only for mobile phone use. The developer could then focus on the design for each. The application for mobile phones should be designed as a native application that could be easily downloaded from an app store to the phone. The laptop or desktop version should be shared with to the user via a link, so the user does not have to type a URL. Separate applications would also allow for more specific layout designs to be tested that could result in easier to use applications easier to use. The developer felt that based on the results of the final application and test, the application was much more useable on a laptop because of the larger screen, and using a mouse allowed for more room for larger text and buttons. Creating a mobile-only version, the developer could focus on the mobile design for buttons that are based more on mobile native application design rather than browser application design.

7.3. Future Research and Development

This research project took on looking at design and develop of an earthquake preparation web mapping application using a certain set of methods and software to meet the needs of older adult users with UI and UX design-based customizations to the application code. Based on this research, different areas can and need to be explored to truly understand designing web mapping applications for older adult users. This section will discuss the future research the needs to be done in order to fully understand the best methods, software, hardware, and deployment strategies to serve the older adult community needs with web GIS applications. Section 6.4.1 discusses the future research needs into UI and UX design for older adults. Section 6.4.2 discusses the future research needs about relevant software. Section 4.2.3 discusses future research needs into hardware used. Section 4.2.4 discusses the future research needs of other web GIS applications geared toward older adults.

7.3.1. Future UI/UX research

Based on the results of this project, more research needs to be conducted into more productive UI/UX changes than just changing button size, text size, and color contrasting. More research needs look into working with older adults with physical ailments that may be harder for them to operate the application in the current design. Future research also needs to be done to look at audio commands and audio instructions for those that have issues seeing and using a touch screen or a mouse. Future UI/UX research needs to be conducted using a focus group of older adults to use different versions of designs in order to compare varying designs. Multiple avenues are available for research in this field to design more user-friendly web GIS applications for older adults.

7.3.2. Future Software Research

For this project, only Esri software, Web AppBuilder framework, and API for Javascript were used for the main design and platform for this application. While the software was able to create an application with the design functionality, some of the UI/UX changes could not be accomplished. Other software needs to be researched that could accomplish all the UI/UX desired changes to images and buttons.

Another issue that was found was that some of the Esri direction services provided in the Nearest Widgets are Esri subscriber only proprietary software that requires credits and tokens to be saved within the application registration. Use of the subscriber content or proprietary software might not be the best long-term solution for an application that needs to be completely open to the public. All services need to be researched more to find services that do not rely on subscriber tokens to work. If the application became widely used, the cost would become a burden for the developing organization. Limits can be set on how much the service can be used, but that would limit the application.

The application was also browser-based, which produced some limitations shown in the testing. For the future, other software needs to be tested to discover the success of the software at creating similar applications with functionality. Other software may provide more functionality such as better customization options to meet the UI/UX needs of the application. Future research into the software used for a web mapping application for older adult users can only increase the success of those types of applications.

7.3.3. Future Hardware Research

Based on the results found with issues into the design for multiple devices using one design, future research must be done on the types of devices would be best for the deployment of the application. The larger font and buttons customizations worked best on devices for larger screens. Future research needs to be done in design for the smaller screen devices that many users have in possession and the device the test group started out with. Research needs to be done into what devices are best for older adult users and what devices older adults use the most so that the design can be better driven toward different devices. As suggested earlier in the document, users would benefit from a separate application designed for different types of devices such as smaller mobile devices over larger scale devices such as laptops and desktops. Hardware research would benefit the success of a web GIS application for older adult users.

7.3.4. Other Applications

The final future research consideration is the need to research other applications geared toward older adults that can be used outside of Los Angeles and for other emergency events. As the research suggests in Chapter 2, older adults benefit for maps and apps designed specifically for them. One of the testers in the focus group mentioned the need for a mapping application for other devices outside of earthquakes. Future research and development need to be done for other emergency events that affect the area, such as wildfires. Another user mentioned that it would be great if the application was design for use outside of LA. This research for this application could be applied to other areas outside of LA and for multiple events. Research into multiple emergency types and pre, during, and post-emergency event should also be done as all parts of emergencies are important, and older adults could benefit from the research into apps for all phases. The field is wide open for research for different types of emergency applications designed for older adult use.

7.4. Conclusions

Overall, the purpose of this application was to research the design and development of a web mapping application for older adults of Los Angeles. The research focused on certain UI/UX design methods to customize the application to test a prototype of the application for older adults. The methods proved successful in developing a functional application; however, some of the designs features and functionality were not as effective as hoped. The results of the application test and discussions will be used in future research and application design and development plans to better ensure a more user-friendly and functional application for older adult users. The outcomes of this project can also be used in the future to be applied to research and design for other web mapping applications designed for older adult users.

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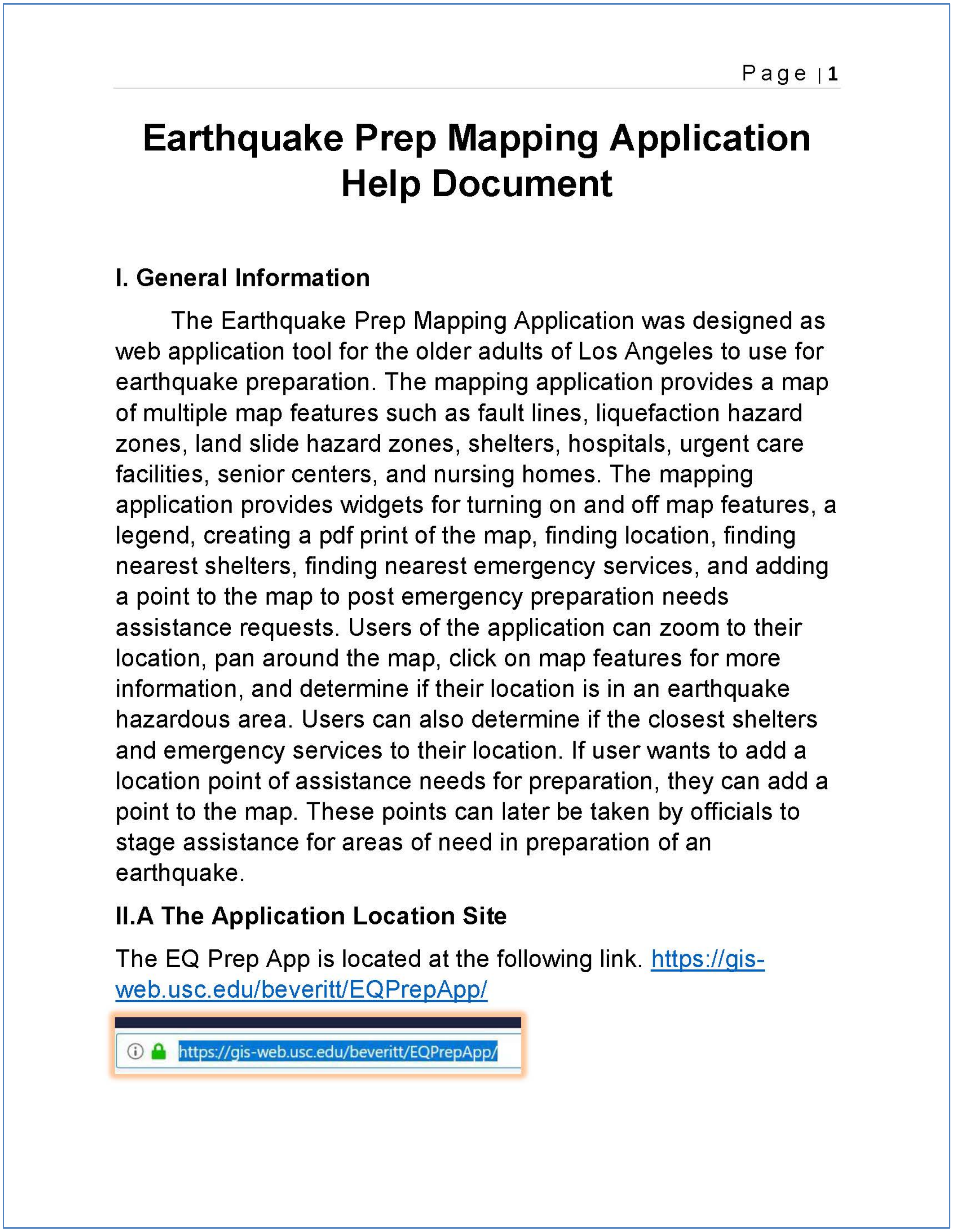
Appendix A



Earthquake Prep Mapping Application Help Document

I. General Information

The Earthquake Prep Mapping Application was designed as web application tool for the older adults of Los Angeles to use for earthquake preparation. The mapping application provides a map of multiple map features such as fault lines, liquefaction hazard zones, land slide hazard zones, shelters, hospitals, urgent care facilities, senior centers, and nursing homes. The mapping application provides widgets for turning on and off map features, a legend, creating a pdf print of the map, finding location, finding nearest shelters, finding nearest emergency services, and adding a point to the map to post emergency preparation needs assistance requests. Users of the application can zoom to their location, pan around the map, click on map features for more information, and determine if their location is in an earthquake hazardous area. Users can also determine if the closest shelters and emergency services to their location. If user wants to add a location point of assistance needs for preparation, they can add a point to the map. These points can later be taken by officials to stage assistance for areas of need in preparation of an earthquake.

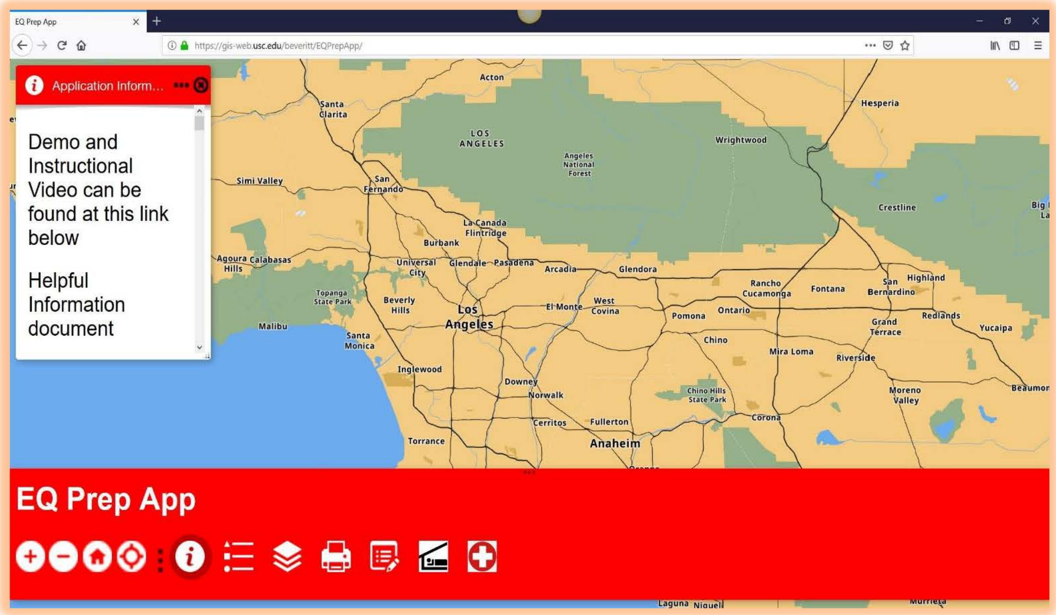
II.A The Application Location Site

The EQ Prep App is located at the following link. https://gis-web.usc.edu/beveritt/EQPrepApp/

https://gis-web.usc.edu/beveritt/EQPrepApp/

II.B. The Application View

When the application is opened in the browser, the application should open to look something like this. Take note that this is a view of the application from a laptop and larger tablet held in landscape. The map is displayed at the top with the widget button bar at the bottom with all of the buttons of the application. Widget button boxes will open in the map view and can be closed by hitting the button again or hitting the “x” button in the box. In a smaller device screen such as a phone, the widget button will take up more of the screen if not the whole screen. The box will need to me minimized by hitting the “three dot” button next to the “x” to see the map again. You can open the box again by hitting the minimized box.



EQ Prep App

https://gis-web.usc.edu/beveritt/EQPrepApp/

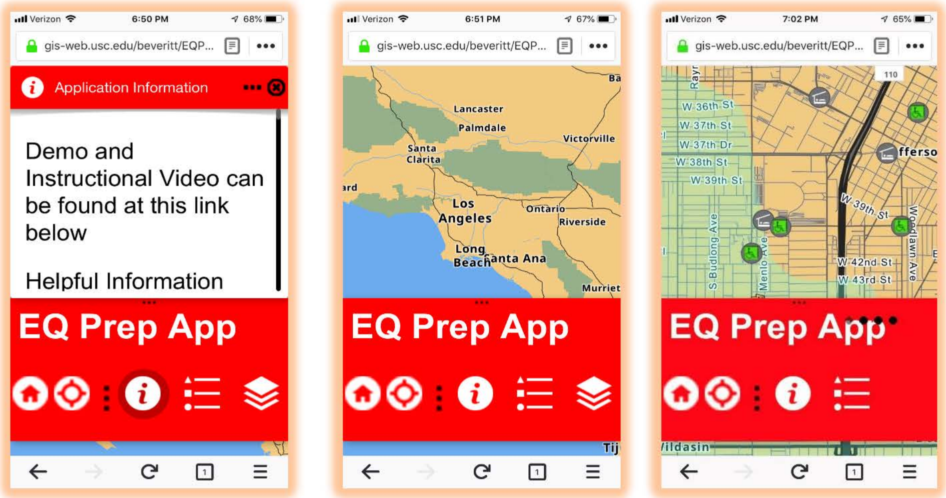
Application Inform...

Demo and Instructional Video can be found at this link below

Helpful Information document

EQ Prep App

Below are views from a smaller mobile phone device.



Demo and Instructional Video can be found at this link below

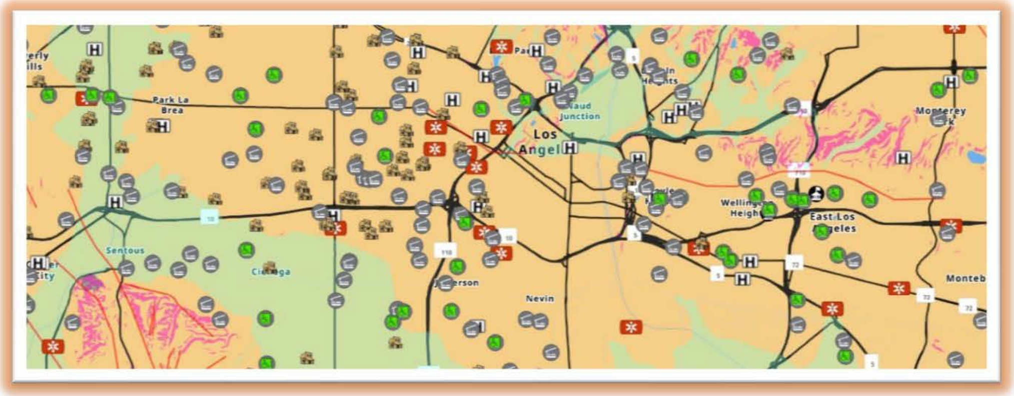
Helpful Information

Because of the application intended design for larger widgets, text, and buttons, it is highly recommended that the application be opened in a larger device such as larger tablet, laptop, or desktop with a larger screen. The application will be much easier to see all buttons, boxes, and the map with a larger screen device.

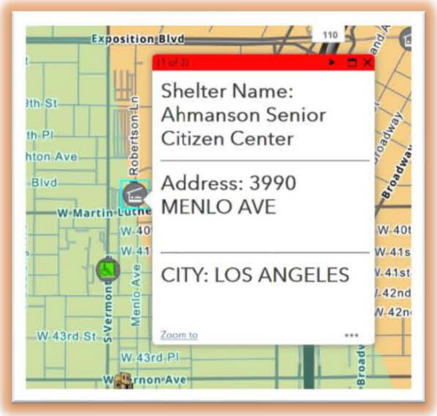
II.C. Parts of the App

This section will explain further the different part of the application. The first will cover the map view. The second section will cover the widget buttons.

II.C.1. The Map



The map displays different location features such as shelters, emergency services, faults, liquefaction zones, landslide zones, and background map for reference. The map is centered on Los Angeles by default. Using a mouse on laptop or desktop or finger on touch screen device, you can pan or zoom in the map. You can touch or click on map features to get more information about the feature in a pop up. Below is a popup example of clicking on a feature in the map.



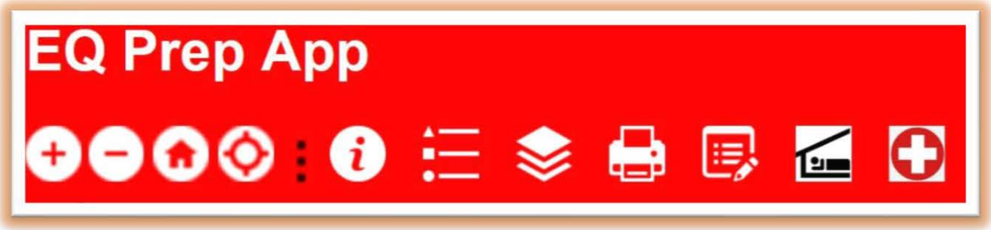
Shelter Name: Ahmanson Senior Citizen Center

Address: 3990 MENLO AVE

CITY: LOS ANGELES

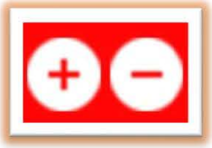
Zoom to

II.C.2. The Widget Button Bar



The widget button bar has all the tools that you can use to perform different actions with the map. On a bigger device you will see all of the buttons. On a small device, you will have to drag your finger across to pull more of the buttons to be available. It's best to view the web mapping application site on a larger device to make it easier to see all of the buttons here.

II.C.2.a. The Zoom Buttons



The Zoom buttons are useful to zoom in and out of the map. The "plus" button zooms in. The "minus" button zooms in. The Zoom buttons are not needed if you have a touch screen device. Zooming can be done by "pinching" the map and moving your fingers closer together. Zooming out can be done by putting two fingers to the map and pushing them apart.

III.C.2.b. The Home Button

The Home button will take you back to the map's default location. So, if you have been moving around in the map, click on the home button if you need to get back to default extent showing LA.

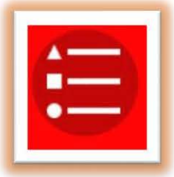
III.C.2.c. The Zoom to My Location Button

The Zoom to My Location will zoom to your GPS location or the location of your wifi connection if your browser is allowed to access your location. If using a mobile device such as a tablet, you may have to check the browser settings in the browser app such as Safari, Chrome, or Firefox. To get back to the overview of LA, press or click the home button.

III.C.2.d. The Application Information Button

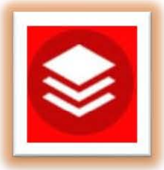
The Application Information Button is open immediately when the application web page is opened. The box displays helpful information such as a links to a demo video of the application and this document. The box also provides disclaimer information for the application explaining the purpose of the application.

III.C.2.e. The Legend Button



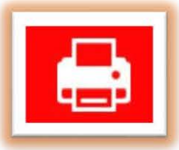
The Legend button will display the legend of the map in a box. The legend will only display map features that are visible on the map. If you zoom in, more map features will be visible and more features will be displayed in the legend.

III.C.2.f. The Turn On/Off Layers Button



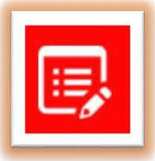
The Turn On/Off Layers button will open a box that will show a list of the map features with check boxes next to them. If the box is checked, the map feature will be on. If the box is not checked, the map feature will be turned off. If the map feature is greyed, the map feature will on turn on when the map is zoomed in closer.

III.C.2.g. The Print Widget Button



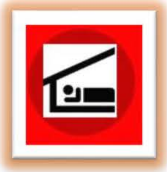
The Print button will open a box that will allow you to print a map off by selecting a few options and hitting print. This will allow you to save a pdf of the map view off to view later.

III.C.2.h. The Add Assistance Request Point Widget Button



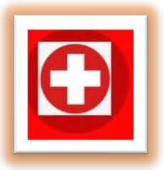
This button will open a box that will allow you to chose a type of assistance request that you may have for earthquake preparedness. The button will allow you to make a point on the map at a chosen location with a symbol for that type of request.

III.C.2.i. The Nearest Shelter Widget Button



This button will open a box that will allow you to find the nearest shelters to a given location. You can use the “zoom to my location” button to zoom to your location first or you can use the search bar to search for location or pick a location by clicking the balloon icon first then clicking on the map. This will return shelters that are close to that location up to 5 miles based on the setting. You can move the setting from 1 to 5 miles.

III.C.2.j. The Nearest Emergency Service Widget Button

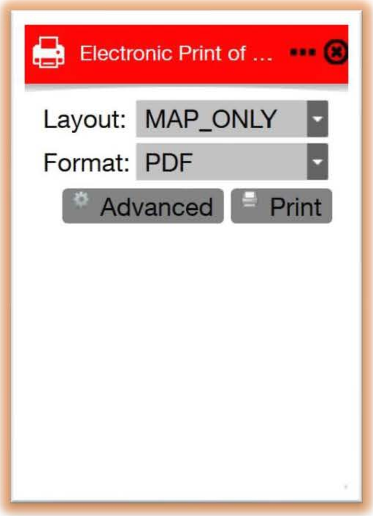


Similar to the nearest shelter button, this button will open a box that will allow you to find the nearest emergency services (hospitals and urgent care facilities) to a given location. You can use the “zoom to my location” button to zoom to your location first or you can use the search bar to search for location or pick a location by clicking the balloon icon first then clicking on the map. This will return the emergency services that are close to that location up to 5 miles based on the setting. You can move the setting from 1 to 5 miles.

III.C.3. The Widget Boxes and Tasks

This section will explain the individual widget boxes that pop up when you click on the buttons. Since the Application Information, Turn On/Off Layers, and Legend button were further explained, those buttons will not be in this section. This section will also explain how to perform tasks with the widget buttons and boxes.

III.C.3.a The Print Widget Box

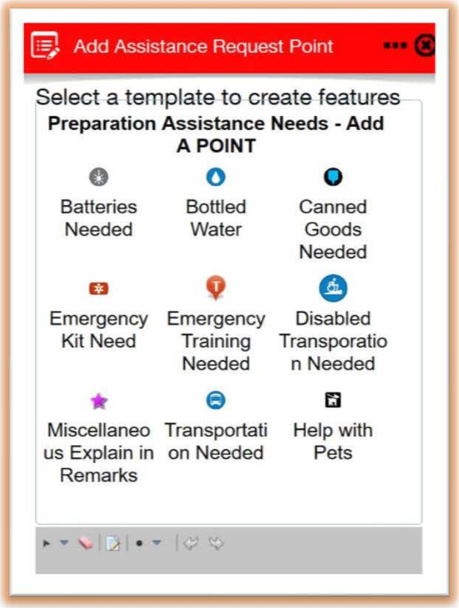


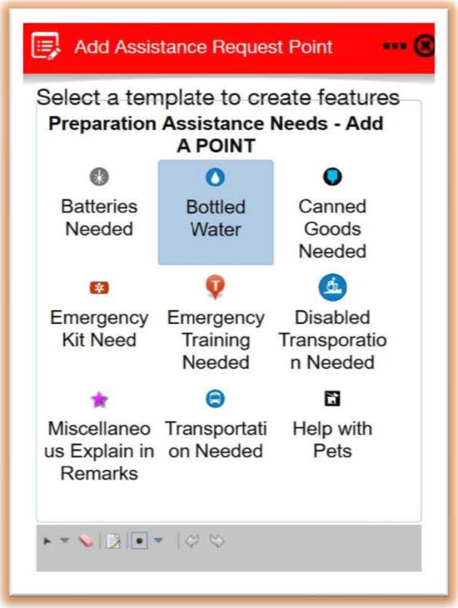
Layout: MAP_ONLY

Format: PDF

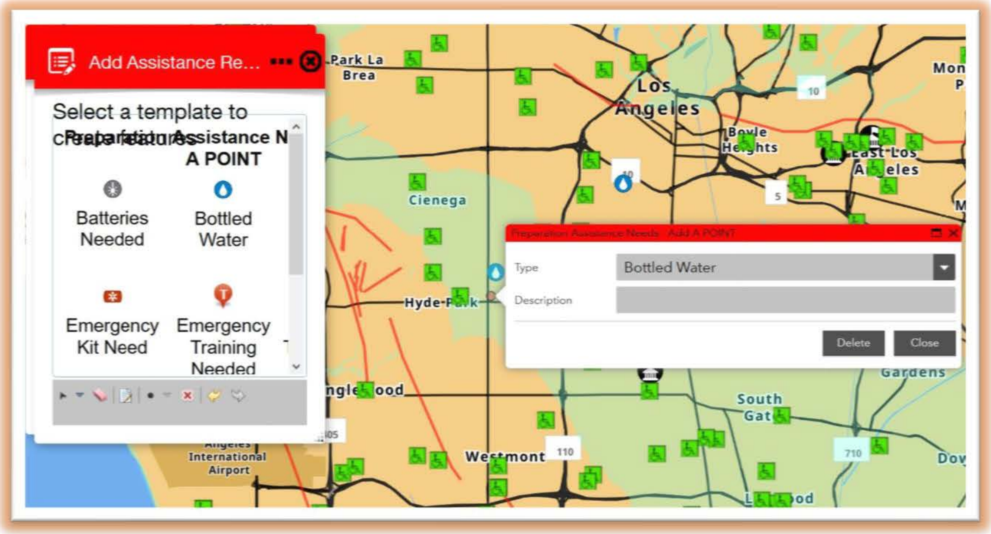
The print widget box shows the layout picker to pick what part to print, the format to print to, and the print button. Everything is set to default to print the map without the legend and to print to a pdf. The print button will start the print and show the print to download when finished. Any unwanted prints can be cleared. To close this box, just hit the “x” in the top right corner.

III.C.3.b. The Add Assistance Request Widget Box


Add Assistance Request Point
Select a template to create features
Preparation Assistance Needs - Add A POINT
Batteries Needed
Bottled Water
Canned Goods Needed
Emergency Kit Need
Emergency Training Needed
Disabled Transportation Needed
Miscellaneous Explain in Remarks
Transportation Needed
Help with Pets


Add Assistance Request Point
Select a template to create features
Preparation Assistance Needs - Add A POINT
Batteries Needed
Bottled Water
Canned Goods Needed
Emergency Kit Need
Emergency Training Needed
Disabled Transportation Needed
Miscellaneous Explain in Remarks
Transportation Needed
Help with Pets

The Add Assistance Request Point box allows you to select from 9 different choices to add a point to the map at a chosen location. You select the assistance request need you might have for earthquake preparedness and add it to a chosen location on the map. The one you chose will highlight in blue. Then, you pick the point on the map. If the box is covering up the map, hit the three point (ellipse) at the top right, and you can then pick the point on the map. When the point is on the map, you will get a pop-up box to add any further description to the point. This gives you the ability to interact and add to the map. Please note that you will have to be zoomed in to the options to add points to the map. The pictures on the next page show how to add a point.



Add Assistance Re...

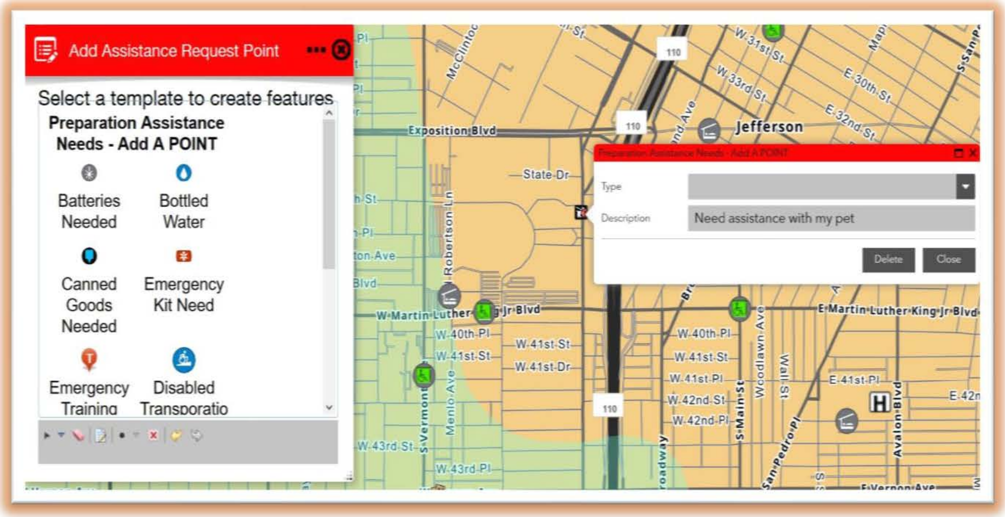
Select a template to create features

Preparation Assistance N A POINT

Preparation Assistance Needs - Add A POINT

Type: Bottled Water

Description:



Add Assistance Request Point

Select a template to create features

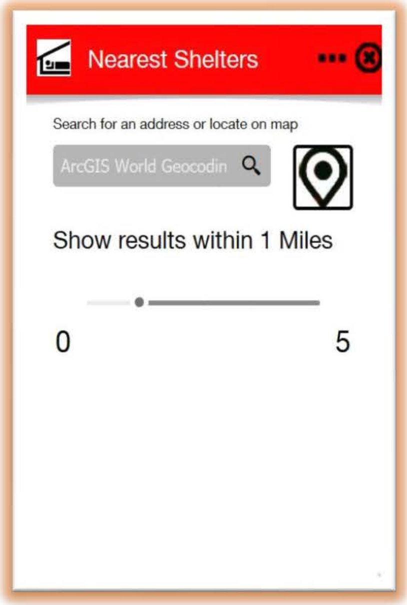
Preparation Assistance Needs - Add A POINT

Preparation Assistance Needs - Add A POINT

Type:

Description: Need assistance with my pet

III.C.3.c Nearest Shelter and Nearest Emergency Service Widget Boxes



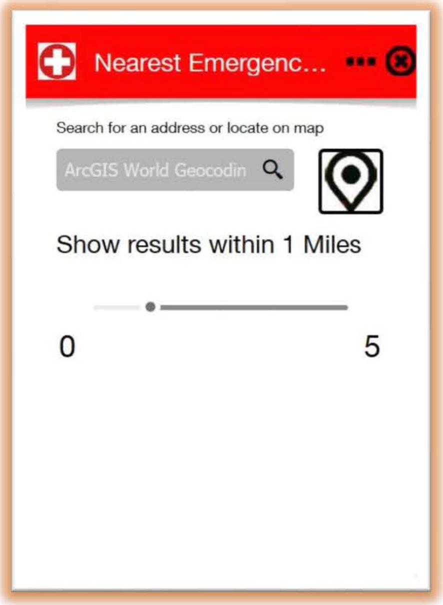
Nearest Shelters

Search for an address or locate on map

ArcGIS World Geocodin

Show results within 1 Miles

0 5



Nearest Emergenc...

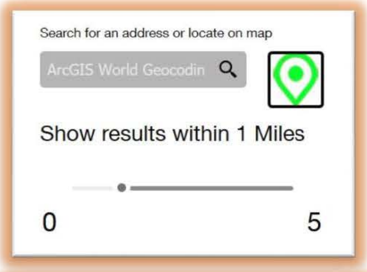
Search for an address or locate on map

ArcGIS World Geocodin

Show results within 1 Miles

0 5

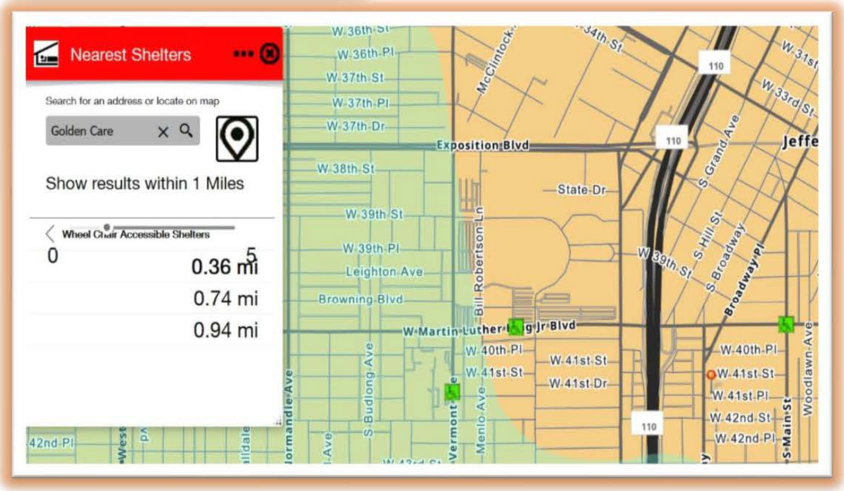
The nearest boxes both work in the same way. When you click on the buttons these boxes will appear. You can search for location to find the nearest shelters or emergency services, or you can use pick the balloon. It will turn green when picked, you can then pick a place on the map to search around. The 0 to 5 is how many miles you want to search around the location you picked. When you search, the amount of features will be shown below with a count of how many. You can pick a feature, and then be shown the closest one. When you pick on the closest one, it will highlight on the map and tell you what the feature is. Screenshots on the next page show the process of searching for the nearest shelter or emergency service.



Search for an address or locate on map

ArcGIS World Geocodin

Show results within 1 Miles



Nearest Shelters

Search for an address or locate on map

Golden Care

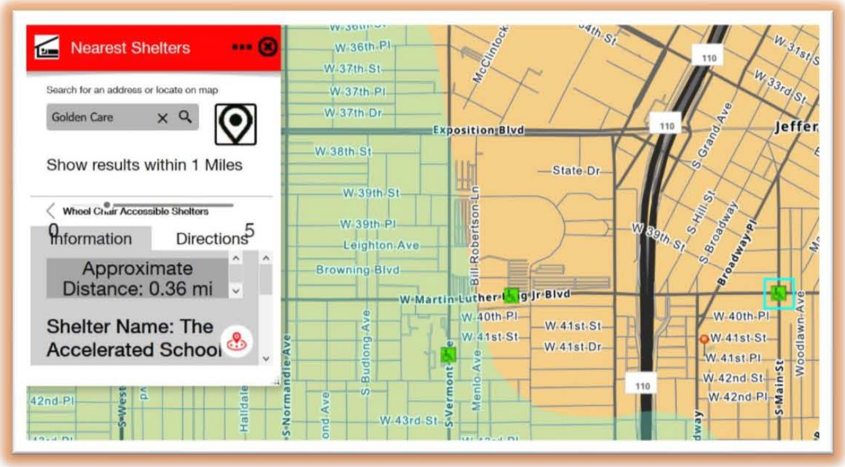
Show results within 1 Miles

Wheel Chair Accessible Shelters

0.36 mi

0.74 mi

0.94 mi



Nearest Shelters

Search for an address or locate on map

Golden Care

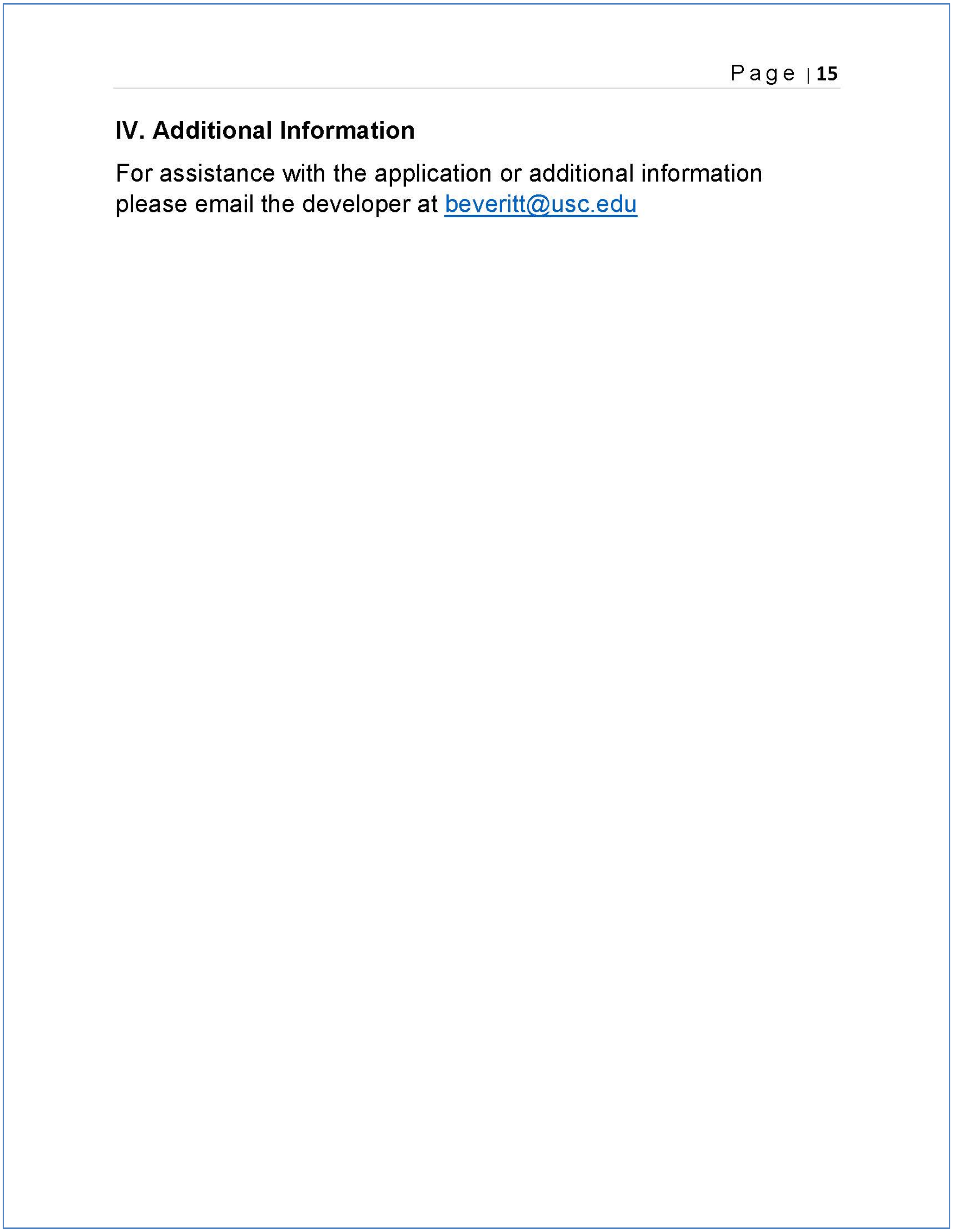
Show results within 1 Miles

Wheel Chair Accessible Shelters

Information | Directions

Approximate Distance: 0.36 mi

Shelter Name: The Accelerated School



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IV. Additional Information

For assistance with the application or additional information please email the developer at beveritt@usc.edu