ANNIVERSARY BUSHFIRE EXHIBIT

sponsored by the Fire Services Museum of Victoria

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Anniversary Bushfire Exhibit

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Sponsored by the Fire Services Museum of Victoria

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Acknowledgments

Abstract

Our team developed a travelling museum exhibit for the Fire Service Museum of Victoria to present the impact of major Victorian bushfires and tell the stories of those affected by them. Our project group researched newspaper, book, and video archives and conducted interviews with firefighters. The gathered information was incorporated into the exhibit in the form of several displays, iPad-based interactive timelines, and museum artifacts. The Anniversary Bushfire Exhibit will be displayed in different locations across Victoria, thus, all exhibit components were designed to be portable and easily configurable to any room size.

Executive Summary

Australian wildfires (known colloquially as "bushfires") affect local communities at all times of the year. The state of Victoria is the location of Australia's most devastating fires, including the Black Friday (1939) and Black Saturday (2009) bushfires.

The prevalence of Victorian bushfires has emphasized the importance of firefighting and its evolution in Victoria. One such organization which maintains this evolutionary history is our project sponsor, the Fire Services Museum of Victoria (FSMV). The museum's mission is to display, preserve, and interpret items pertaining to the history and concepts of firefighting and fire safety in Victoria. In order to provide visitors with an understanding of Victorian bushfire impact, and to commemorate the upcoming 80 and 10 year anniversaries of the Black Friday and Black Saturday fires respectively, the FSMV asked our group to develop an exhibit which encompasses these themes. In addition, the FSMV requested for this exhibit to be portable, as it will move between different locations across Victoria.

Our project group researched newspaper, book, and video archives and conducted interviews with firefighters. The gathered information was transposed into the Anniversary Bushfire Exhibit which presents the impact of the major bushfires in the state of Victoria and tells the stories of those affected by the fires. This exhibit consists of three components: interactive timelines, displays, and artifacts.

The *Interactive Bushfire Timeline* contains information about 15 of the most devastating fires in Victoria's history. The information is presented through short paragraphs about every fire, as well as images depicting the fires. The second timeline, the *Interactive Personal Accounts Timeline*, presents the stories of individuals who were affected by bushfires. These

personal accounts are told through quotes, stories, and videos our team gathered through research and personal interviews.

Aside from the two interactive timelines, this exhibit includes five hanging displays that show information relating to: how bushfires start and spread, the Black Friday and Black Saturday fires, the social impact of bushfires, the evolution of the fire services in Victoria, and the firefighter peer support program. In addition to the five printed displays, our group built portable wooden frames and stands on which the displays can be hung. This means the Anniversary Bushfire Exhibit has both a wall-hung and free-standing configuration, allowing it to be set up in any size room.

The last component of the exhibit consists of artifacts we obtained through the Fire Services Museum of Victoria. These artifacts present the evolution of firefighting technology over the years, giving the exhibit an additional visual dimension.

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Abbreviations

BFBA - Bush Fire Brigade Association

CFA - Country Fire Authority

CFBB - Country Fire Brigade Board

FSMV - Fire Services Museum of Victoria

MFB - Metropolitan Fire Brigade

MFBB - Metropolitan Fire Brigade Board

Introduction

The continent of Australia is one of the most fire-prone locations in the world due to its hot and dry summer climate. Every year, thousands of Australian wildfires, known as "bushfires", lead to significant social and environmental impacts, greatly affecting local communities. Two of the most devastating fires in Australia occurred in the state of Victoria in the years 1939 (The Black Friday fires) and 2009 (The Black Saturday fires). These bushfires, along with many others that have occurred in Victoria's history, ravage the land and communities, destroying homes and statewide economic assets (Forest Fire Management Victoria, 2017). Many lives have been lost in bushfires as well, affecting families and the Victorian community at large.

The Fire Service Museum of Victoria (FSMV), located in Melbourne, Australia, is dedicated to preserving and protecting the memorabilia, artifacts, and stories of the Victorian fire services departments (Fire Services Museum of Victoria, 2013). Currently, the museum does not have an exhibit dedicated to the Black Friday and Black Saturday bushfires, nor does it have any commemorative display to honor those affected by the fires.

The year of 2019 marks the 10th and 80th anniversaries of the Black Saturday and Black Friday fires, thus, the FSMV wishes to memorialize the bravery of the service members who worked during these natural disasters. In recognition of the anniversaries, the FSMV tasked us with developing a new exhibit that presents the impact of Victorian bushfires and the stories of those affected by them. In addition, the FSMV plans to move the exhibit between different locations in the state of Victoria throughout 2019.

The exhibit components consist of an interactive timeline, stationary displays, and firefighting artifacts. The interactive timeline presents the major fire events in the state of Victoria in chronological order, starting from the Black Thursday fires (1851) and ending with the St. Patrick's Day fires, which occurred this past year (2018). The displays present information regarding how bushfires start and spread, the Black Friday and Black Saturday bushfires, the social impact of bushfires, the evolution of fire services in Victoria, and the firefighter peer support system. The informational content of the exhibit is comprised of newspaper, book, and video archive research. Additional information and personal accounts were

obtained through firefighter interviews.

By developing a commemorative bushfire exhibit, the museum aims to educate individuals about the history and effects of the bushfires that occurred in Victoria over the past 167 years. The exhibit also highlights the actions taken by the brave emergency service workers who fought the fires, and the dangers they faced.

Background and Exhibit Content

2.1 History and Mission of the Fire Services Museum of Victoria

The sponsor for this IQP project is the Fire Services Museum of Victoria (FSMV). Located on 39 Gisborne Street in East Melbourne, the FSMV's mission is to display, preserve, and interpret items pertaining to the history and concepts of firefighting and fire safety in Victoria. The Fire Services Museum of Victoria originated in 1972 as the Melbourne Fire Brigade Society. When a number of people became concerned by the amount of Metropolitan Fire Brigade (MFB) material being lost or disposed of, they began gathering items, holding them privately until a central repository was established, forming the beginnings of the FSMV. The museum has been open to the public since 1979 to provide a home and focus for firefighting services in Melbourne and the surrounding state. The FSMV is a non-profit organization, and is reliant on volunteers, donations, and admission fees. Residing in the old head office of the Melbourne Fire Brigade, the museum includes a collection of over 10,000 fire-related items and memorabilia collected both nationally and internationally. (Fire Services Museum of Victoria, 2013).

2.2 Anniversary Bushfire Exhibit

Australian communities and firefighters face dangerous bushfires on an annual basis. The year of 2019 marks the anniversary of the Black Friday and Black Saturday Bushfires, two tragic fires which occurred in Victoria in 1939 and 2009 respectively. To recognize these anniversaries, the FSMV asked us to develop a new interactive timeline exhibit that presents the impact of these fires and the stories of those affected by them.

The Anniversary Bushfire Display is intended to be jointly curated with the help of the FSMV staff. The information presented in the display is derived from interviews, artifacts, and collected bushfire data. Interviews provide firsthand accounts to encourage feelings of emotion and realism in the exhibit. The FSMV possesses many useful artifacts, some of which are exhibited in unison with displays to create the commemorative Anniversary Bushfire Exhibit.

2.3 Introduction to Wildfires

Wildfires have been affecting Earth's surface and atmosphere for over 350 million years (Doerr & Santin, 2016), far longer than humans have existed. Millions of years ago, fires were caused by naturally-occurring events which served beneficial purposes in transforming the Earth's landscape and refreshing its ecosystems (Doerr & Santin, 2016). Over time, however, human presence has increased fire occurrence and the impact it has on the environment (Doerr & Santin, 2016). Urban environments have also provided a way for wildfires to produce maximum social and physical damage to society. Both natural and manmade wildfires have environmentally positive, as well as societally-detrimental effects.

Wildfires can occur as far north as the Arctic Circle, or as far south as Australia (Taylor-Coleman, 2018). Regardless of the location, wildfires can start due to a variety of reasons, with most being tied to human interactions. Fires flourish if they have the three key resources available to them: heat, fuel, and oxygen (Taylor-Coleman, 2018).

Solar heating and lightning strikes are the primary natural catalysts for fires, however, most fires develop from man-made carelessness (such as barbeque charcoals, discarded cigarettes, or arson) (Taylor-Coleman, 2018). The type of fuel which the fire consumes is dependent on the weather and environment. Dry winters and springs can leave scrubland and grasslands especially flammable (Taylor-Coleman, 2018). High wind conditions can help the fire spread to new locations as well as provide further oxygen to the fire causing it to grow in size and effect. The rate at which the fire spreads is also dependent on the weather conditions. At high wind speeds, burning embers can be carried along wind currents to start new fires kilometers away (Taylor-Coleman, 2018). Sometimes, lightning strikes on tall trees can create the initial kindling of a treetop forest fire. Treetop fires tend to expedite the spreading process as they are vulnerable to high winds and difficult to control compared to slower-moving surface fires along the forest floor (Taylor-Coleman, 2018).

Many of the negative impacts of wildfires occur from human actions which expedite an initially natural process. Propagation of deadly wildfires can take place in urban environments due to the plastics, rubbers, and chemicals which reside in them (Taylor-Coleman, 2018). Nearby homes and vehicles can easily combust under intense heat, even without the flames physically touching them (Taylor-Coleman, 2018, Doerr & Santin, 2016). During the July 2018 fire in

Athens, Greece, cars in the road caught fire before the surrounding trees because they were more flammable. The amount of energy radiated by fires is enough to ignite car tens of meters away from the physical flames. In addition, the smoke from burning materials is sometimes more deadly than the hot flames, causing irreversible lung damage (Taylor-Coleman, 2018).

Humans changing the landscape can also increase an area's proneness to fire. One example of this is the movement of Southern European farmers to more-industrialized areas in Europe at the start of the 20th century. With people leaving their agricultural lands for more urban environments, the regions became overgrown with vegetation, allowing for fires in such areas to spread more easily (Taylor-Coleman, 2018).

2.3.1 How Bushfires Spread

Bushfires often start as small, isolated fires that combine due to high wind speeds and flammable foliage. Once a bushfire begins, several factors affect how it will spread. The fire's fuel is an important factor in determining the fire's intensity and duration. Dry grass will supply a bushfire with plenty of fuel to burn ferociously on the ground, whereas crown fires spread among the treetops. Topography impacts the rate at which a bushfire spreads, doubling the fire's speed with every 10° of incline (Bushfire Basics). Weather conditions can also force the fire to spread quickly and unpredictably. High winds help the fire spread to new locations as well as provide further oxygen to the fire causing it to grow in size and effect. These winds carry burning embers high into the sky, creating fireballs which can travel kilometers away (Simeoni, 2018). When the embers rain down, they spark up new fires in unexpected places (called "spotting"), further spreading the blaze. A sudden wind change can also manipulate the direction of a fire, transforming a long flank into an enormous new head (Simeoni, 2018).

Once a bushfire begins to move towards urban and suburban communities, large groups of people are put at risk. Houses and vehicles can combust easier than the natural land, and embers landing on rooftops can cause entire communities to burn to the ground. Once a large fire begins to grow, it is difficult to extinguish the flames as wind shifts and extreme heat create dangerous situations for fire personnel.

2.3.2 Why Australia?

The continent of Australia is the most fire-prone location in the world due to its hot and dry weather conditions. The widely varied fire seasons are reflected in the continent's different weather patterns. For most of southern Australia, the danger period is summer and autumn. For New South Wales and southern Queensland, the peak risk usually occurs in spring and early summer. The Northern Territory experiences most of its fires in the winter and spring (Bushfire Basics).

While there are different types of wildfires, bushfires and grassfires are the most common throughout Australia. Bushfires and grassfires can cause a great deal of damage, yet they are an essential part of Australia's ecosystem and have been occurring long before humans inhabited the land. Many of Australia's native plants are packed with highly combustible fuel, however, numerous other plant species depend on fire to regenerate. For example, some species of trees will only drop their seeds under the extremely high temperatures caused by a bush or grass fire. (Bushfire Basics).

Furthermore, the eucalyptus tree which is native to Australia, helps fuel wildfires. The leaves of the eucalyptus are full of toxic eucalyptus oil which evaporates on hot days. The oil, in addition to the dry leaves that fall to the forest floor, make the tree extremely flammable. The tree burns uniquely as the trunk usually remains alive. After a bushfire, the trunk can sprout new limbs and regenerate unlike other trees, which have to re-sprout from the roots (Grant, 2018).

2.4 Impact of Wildfires

In this section, the impacts of wildfires on a social, environmental, and economic level will be touched upon. While wildfires can yield long-term benefits for a natural ecosystem, the destructive aspects of wildfires can greatly affect societies and their surrounding environments. A wildfire's impact can be felt not only in the danger zone of the flames but kilometers away, stretching to towns and cities where people might assume they are safe.

2.4.1 Environmental Impacts

Wildfires create many environmental problems as they destroy land and create pollution. In Australia, where bushfires and wildfires are extremely common, many agricultural businesses which rely on the environment feel the impacts of fires commercially. For example, the timber industry in Australia suffers each year from burnt trees. In 2003, the Alpine and Canberra fires resulted in AUD 1.49 billion in timber losses as fires were so intense, little wood could be salvaged after the blaze (Stephenson, 2010). Australian timber companies attempt to mitigate their timber losses after wildfires by sending crews into a forested area to save any wood that remains in usable condition.

Timber is not the only natural resource affected by wildfires. The grape industry in Australia also sees significant losses as a result of wildfires. Smoke plumes can reach grape fields great distances away causing them to spoil just through smoke contact. In the 2009 Black Saturday fires, AUD 330 million in grapes were destroyed (Stephenson, 2010).

Streams and rivers that provide fresh water to populated areas can be polluted with the high levels of carbon, nitrogen, and phosphorus that remain on burnt land after wildfires (Corbin, 2011). Fortunately for Australia, wildfires usually occur during a drought, and consequently, these pollutants cannot be transported since there is no rain to wash pollutants into bodies of water.

The atmospheric changes that result from large fires can cause health problems for anyone living near them. Wildfires burn fuel such as carbon, which can be found in all species of plants. These fuels combust into chemicals that drift into the atmosphere in the form of smoke. Compounds such as NMOCs and NOx are the precursors for the dangerous pollutant ozone (O_3), which forms in the smoke plume of a wildfire (Jaffe, 2012). The process of a fire turning chemicals into ozone is very complex and hard to study, but researchers have found that high levels of ozone can reach cities and towns due to wildfires. This pollutant can cause short-term mortality, irritated lungs, bronchitis and asthma (Jaffe, 2012). Urban dwellers may feel as though they live in safe areas while wildfires burn the lands around them, however, smoke plumes from the flames cause health risks that can travel hundreds of miles.

Intense flames from fires transform the natural soil chemistry due to the fires' high heat, ash, and debris. Fire depletes the soil of organic matter and nutrients such as plant roots, fungi, nitrogen, sulfur, bacteria, phosphorus, and calcium. The organic matter and nutrients combust into the air and leave the soil unable to grow plants. Some factors that determine how long it takes soil to recover include the type of vegetation, the intensity of the fire, and the amount of water taken in (Tulau, 2015).

In contrast to the short-term environmental damage, many wildfires provide the land in which they occur with valuable nutrients and leave environments replenished for species inhabiting the area. Trees can grow upwards of 100 feet and stretch far and wide with their green canopies. A tree's branches reach as high as possible in order to receive more sunlight than its neighbors. This competitive cycle leaves the forest floor in shade, leaving few locations where a new sapling can grow. When a fire rips through a forest, sunlight reaches the forest floor allowing for many new trees to dig in their roots and sprout up. After a disastrous fire, many trees lose their seeds to the extreme heat; however, evolution has gifted some trees with serotinous cones. These special pine cones designed for heat cling to their seeds for upwards of 10 years and will only drop seeds in extreme temperatures. Trees with this capability can quickly replenish its population after a wildfire (Bradstock, 1994). Thus, fires can promote new, healthy growth by clearing away old plants and brush, leaving the revitalized soil barren.

Australian firemen have the difficult task of determining which fires can be considered environmentally "natural" or ultimately destructive when considering which fires to extinguish. While bushfires can be dangerous to humans and urban populations, suppressing all possible bushfires would prevent ecologically positive fires from occurring.

2.4.2 Social Impacts

Wildfires can profoundly impact people on a personal and communal level. On an individual level, life-threatening events such as bushfires often cause physical and psychological trauma that can have long-term effects. A report conducted by The Australian Business Roundtable for Disaster Resilience & Safer Communities found that in the state of Victoria alone, the estimated social costs associated with the Black Saturday bushfires, were larger than the financial costs. Direct health care system costs, productivity losses, and justice system costs

amounted to at least AUD 3.9 billion in social impacts, while AUD 3.1 billion amounted in direct financial impacts (Tehan, 2016).

A research study conducted by Deloitte Economics on the Economic Cost of the Social Impact of Natural Disasters in Australia found that weather disasters such as bushfires, cyclones, floods, and earthquakes cause an increase in cases of mental health issues, alcoholism, domestic violence, chronic disease, and short-term unemployment (Tehan, 2016).

When a natural disaster first destroys a community, the members of that community may find it hard to rely on each other for emotional support, as there is no longer a common space for the community to gather and assist one another. As time passes and the initial shock fades away, communities find themselves closer than ever as families work together to rebuild their towns. On a social level, friends, families, and communities find themselves separated from their loved ones, causing personal stress. A study funded by the Joint Fire Science Program found that wildfires disrupt the lives of workers, employers, and families, in addition to creating longer-term instability in local labor markets (RedOrbit, 2012).

The State Government of Victoria researched the effects of emergencies on psychological and social well-being. The report states that the impact of exposure to emergency events on an individual's emotional and mental health can be mild or severe; short-term or long-lasting. There is consistent evidence that up to 40% of people involved in an emergency event are at risk of sustaining severe and protracted psychological injury (Tehan, 2016).

2.4.3 Community Resilience

Community resilience is an action plan that allows for a community to properly respond, withstand, and recover from adverse situations such as bushfires. Over the years, the CFA(Country Fire Authority) has taken the role of educating the Victorian communities on the importance of fire safety. In the aftermath of the Black Saturday fires, the government, emergency forces, and Victorian communities agreed that there was a need for a stronger bushfire resilience plan, thus, the CFA refined its strategy towards creating a more resilient Victoria (CFA Strategy Towards Resilience 2013-2018). Today, the CFA aims to reduce the incidence and impact of fire emergencies on the community of Victoria by encouraging forest cleanups before the start of the fire season, providing educational talks about how to prepare for

bushfires, and informing the public on how to properly evacuate in a state of emergency (CFA Strategy Towards Resilience 2013-2018).

2.5 Peer Support

Firefighters are exposed to a range of tasks which can impact their somatic and mental wellbeing (Duran, 2018). A multitude of incident-related stressors faced by fire service personnel can affect their mental and physical health. These stressors include time, pressure, lack of sleep, fatigue, high stakes decision making, the risk of injury to self or death (Duran, 2018). Large-scale wildfires can exponentially increase the effects of these stressors, often leading to the onset of Post-Traumatic Stress Disorder (PTSD).

2.5.1 Ash Wednesday Impact

One of the most overlooked, yet impactful changes the Ash Wednesday fires had was the support system that was created post-fire. Before 1983, showing any signs of mental trauma or stress after an event was seen as a sign of weakness. Many people questioned if mental illnesses such as PTSD were even real (Darcy, 2018). The Ash Wednesday fires opened many people's eyes to the real impact tragic events such as a bushfire can have on a person's mental health.

In 1984, a program consisting of support staff was informally opened to provide firefighters with a safe space where they could talk about the hardships they face on the job. Before this system was put in place, many firefighters avoided talking about any issues they were dealing with as they did not want to seem cowardly. (Darcy, 2018). This resulted in firefighters retiring, only to then deal with the onset of PTSD in the following years. The newly-formed peer support system that arose after the Ash Wednesday fires became an important structure for firefighters to lean on when they were in need (Darcy, 2018).

2.5.2 Peer Support Initiated

In 1992, a formal program of support was opened to assist fire service members. Initially, 12 volunteers served as peers, all equipped with pagers and were on call 24/7 in case anyone needed to talk with them.

In the early stages, peers tried to changed the way firefighters saw their support program by spreading the motto: "It's alright to not be alright" (Darcy, 2018). Firefighters were encouraged to talk to peers after situations that could have negatively impacted their mental health. The proactive approach these peers displayed persuaded more firefighters to sit down and discuss their experiences. All information shared was kept in complete secrecy to ensure those with psychological trauma felt comfortable opening up to help. Soon after 1992, the fire service community saw the popularity of the peer support system grow, and fewer firefighters were resorting to negative means of alleviating stress (such as alcohol, drugs, prescription meds, and isolation from family members and friends) (Darcy, 2018).

2.5.3 Peer Support Today

Today, there are 85 peer members in the Melbourne Fire Brigade, with three internal psychologist who are on call at all hours of the day. Unlike in the early days of peer support, it is now a common practice for firefighters to seek help after a traumatizing experience.

Firefighters of both the MFB (Metropolitan Fire Brigade) and CFA also serve as first responders to any situation referred to as "priority 0", meaning a victim is either unconscious or not breathing (Darcy, 2018). As a result of this, many fire service members will witness horrible sights such extreme injury or death. It is after these critical incidents that a peer member will reach out to the fire service worker to assess his or her mental state. Since everyone responds differently to trauma, each situation is handled in a manner that best suits that firefighter. Today, the peer program extends beyond the active firefighters, providing assistance to their families as well as retired fire service members. The success of the peer support program has helped about 100 retired firefighters every year, and continues to assist active members as they deal with traumatizing events (Darcy, 2018).

2.6 Major Fires in Victoria from 1851-2018

This section discusses the major Victorian bushfires that are incorporated into our interactive bushfire timeline. Due to the upcoming anniversaries, the Black Friday and Black Saturday fires have an additional component within the exhibit, outside of the timeline itself in the form of a display.

2.6.1 Indigenous Fire Management

Prior to the arrival of Europeans to Australia, the indigenous people practiced controlled fire burning. Since they were nomadic people, the Aborigines were very knowledgeable of the behaviour of fires and their potential environmental impacts. They regulated the plants and animals by choosing when to set an intentional fire (Bowman, 2018). The Aboriginal people used to ignite fires and leave the burning area, returning once the land had recovered and become populated with new vegetation and game animals. Indigenous fire management was performed by lighting "Cool" fires in the early dry season between March and July when fuel loads were low. "Cool" fires burn slowly, reducing the existing fuel loads and creating fire breaks (Indigenous Fire Management).

The reduction of fuels in the soil prevented disastrous wildfires in the living areas of the indigenous peoples (Bowman, 2018). As Europeans settled in Australia, they removed the Aboriginals from their traditional lands, halting the thousand year old fire management practices. The Europeans lacked the fire management knowledge the Aboriginals possessed and that showed in the years following their settlement in Australia. After a major bushfire in 2013 in the state of New South Wales, the Prime Minister Tony Abbott said, "Before Europeans arrived Aboriginal people were practising a form of fire management that in some respects was more successful than that which has been practised since" (Korff, Aboriginal Fire Management).

2.6.2 Black Thursday - 1851

As Aboriginal fire management practices faded, the risk for a devastating fire increased dramatically. The Europeans were new to the land and were not aware of its susceptibility to fire. The settlers were not prepared to fight an Australian bushfire, and more settlers in the area increased the odds of a fire accidentally starting (Hughes).
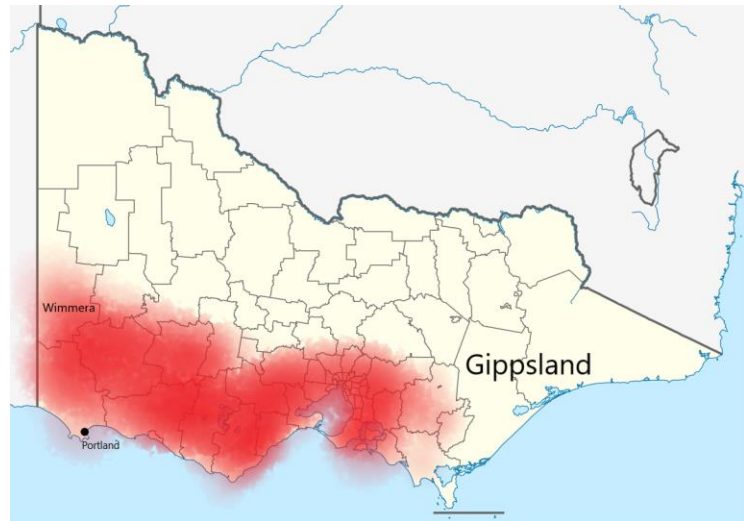
Figure 1: Black Thursday Map

On February 6th, 1851, the temperature in Melbourne reached over 47°C and only a small spark was necessary to ignite the highly flammable brush (Knowledge Hub). According to records found at the FSMV, bushfires were started in Dandenong and spread rapidly throughout the state. The fires raged from Wimmera to the sea and from Portland to the fringe of Gippsland. A quarter of the State of Victoria was burning; approximately 5 million hectares (FSMV Index). Collectively, 12 people were killed, over a million livestock animals were lost, and 1,300 buildings were destroyed (History of Australian bushfires: Interactive, 2013). The Black Thursday fires are known as the first devastating fires in Australia's post-settlement history and is often referred to as the "Day of Terror" (FSMV Index).

2.6.3 Red Tuesday - 1898

On February 1st, 1898 in the South Gippsland area of Victoria, a devastating bushfire began. After the fire had burned 260,000 hectares, affecting the communities of Cranbourne, Traralgon, Neerim South, and
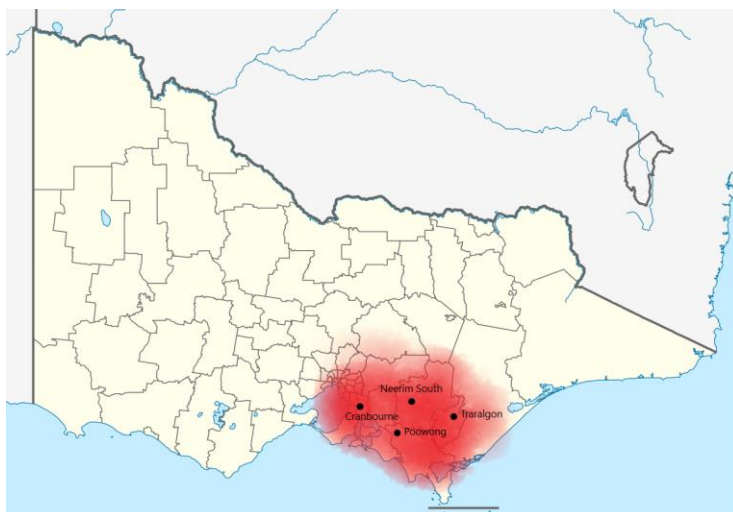
Figure 2: Red Tuesday Map

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Poowong, the settlers in the area began counting their losses. (The Great Heat, 1898). In total, 12 lives were lost and 2,000 buildings and homes were burnt to the ground. In addition to destruction of the landscape, hundreds of cows, pigs, sheep, and horses all perished in the flames. One settler, Mr. F Kelly, was quoted after the fire about all his lost cattle: "If you want roast beef, roast pork, roast veal, roast lamb, or baked potatoes, you may get any of them up at my place. There is plenty of it there, and you can help yourselves." (The Great Heat, 1898).

2.6.4 Black Sunday - 1926

During the summer months of 1925 to 1926 (December-February), Gippsland grazier fires were common in the high country to burn off the old grass to promote new healthy grass growth for sheep and cattle. However, on February 14th, 1926, after a month of drought and high heat, wind gusts of 97 km/h led to many fires joining and growing in intensity. This became the start of Black Sunday. The mass of fires led to 31 lives being lost and 700 injuries. Over 1,000 buildings were burnt down and 390,000 hectares of land was torched across the Gippsland, Yarra Valley, Dandenong Ranges, and the Kinglake area (Black Sunday). Firefighters at the time had little to no coordinated approach to extinguishing these fires and were equipped with only damp hessian sacks and beaters (Black Sunday). Due to the extraordinarily hot temperatures when these fires took place, many cars and other man-made objects could not withstand the overbearing heat. Suburban areas were left riddled with melted vehicles and other smoldering debris.

Figure 3: Black Sunday Map

2.6.5 Black Friday -1939

The Black Friday bushfires began on January 13, 1939. In just two short days, 2 millions of hectares of land burned, while 71 people lost their lives (Forest Fire Management Victoria, 2017). The 6-8 weeks leading up to the fire were extremely dry, while humidity levels were as low as 15% (Lucas, 2009). A mixture of dry heat and strong winds depleted most of the moisture from the ground, leaving the forest floors and open plains dried out with tinder ready to burn.
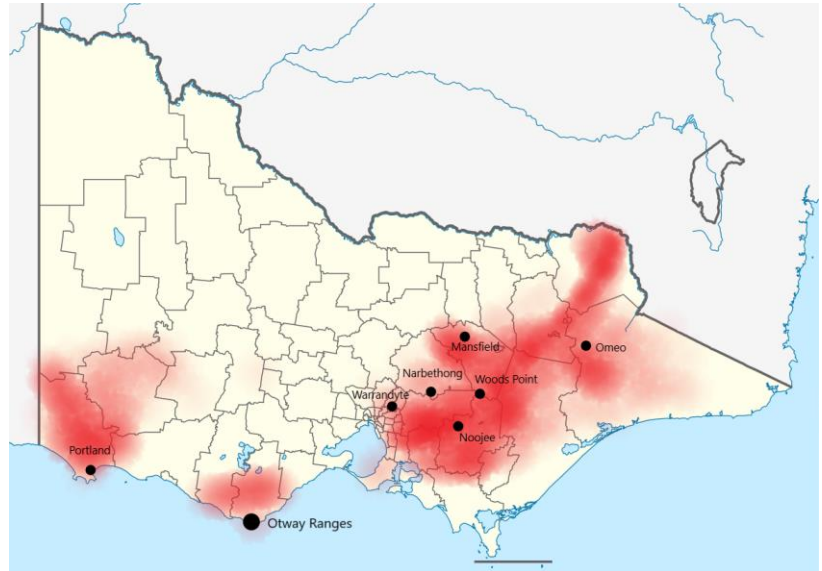
Figure 4: Black Friday Map

The weather conditions created the perfect setting for fires to expand and spread for miles. Several rivers and creeks had dried out from the heat, causing the city of Melbourne to implement water restrictions. January 13th started with several small fires across Victoria which then combined into one massive fire. Most of the fires were started due to humans. In the sawmill town of Matlock, 15 people lost their lives (Forest Fire Management Victoria, 2017). Just to the northeast of Matlock in Wood's point, 143 houses burned down. About 100 homes were burnt in Rubicon, as well as in Warrandyte, and Mansfield (FSMV Index). The fires moved through the mountains of Victoria in the northeast and down along the densely populated southwest coast (Forest Fire Management Victoria, 2017).

In addition to the 71 human fatalities, thousands of sheep, cattle, and horses were lost to the fires. The bushfires burned down a total of 69 sawmills and over 1,000 homes. The area of land burned from the fires added up to about two million hectares of which 575,000 hectares were reserved forests (Forest Fire Management Victoria, 2017). The important parts of the reserve forest included valuable timber such as Mountain Ash trees. The Leadbeater's Possum and Powerful Owl became endangered when their habitat in the natural reserve forest was destroyed in the fires. Ash from the fires traveled as far as New Zealand. The soil took a few

decades to go back to its natural chemistry. Ash, dirt, and debris tarnished several Victorian water supplies for years (Forest Fire Management Victoria, 2017).

The estimated cost of damage from Black Friday was reported to be about AUD 750 million (Australian Institute of Criminology, 2017). As a result, the Victorian Government announced a Royal Commission led by Judge Stretton. A Royal Commission is announced when there is a need for the public to know and understand major events that affect the community (Teague, 2010). Stretton's commission has been described as one of the most significant inquiries in the history of Victorian public administration (Teague, 2010). This commission ruled seven major points of action relating to fire safety and forest management, as well as the operation of the fire services in Victoria, which would ultimately create the CFA. Judge Stretton of the Supreme Court recommended a provision of the Forest Acts 1939, allowing the Department of Environment, Land, Water, and Planning to take authority of fire prevention on public land in Victoria. The other points included protection of forests through a program of controlled fire burning in the spring and autumn, building fire towers throughout forests, upgrading firefighting equipment and training, and using aircraft to locate and water down fires (Forest Fire Management Victoria, 2017).

2.6.6 1943-1944 Bushfires

The summer of 1943-44 marked a turning point in the history of Victoria's fire services. It was the driest summer ever recorded in the state, with only 46 mm of rain falling in the city of Melbourne, about a third of the average for the summer season. (Gamble, The Beaumaris Bushfires of 1944).
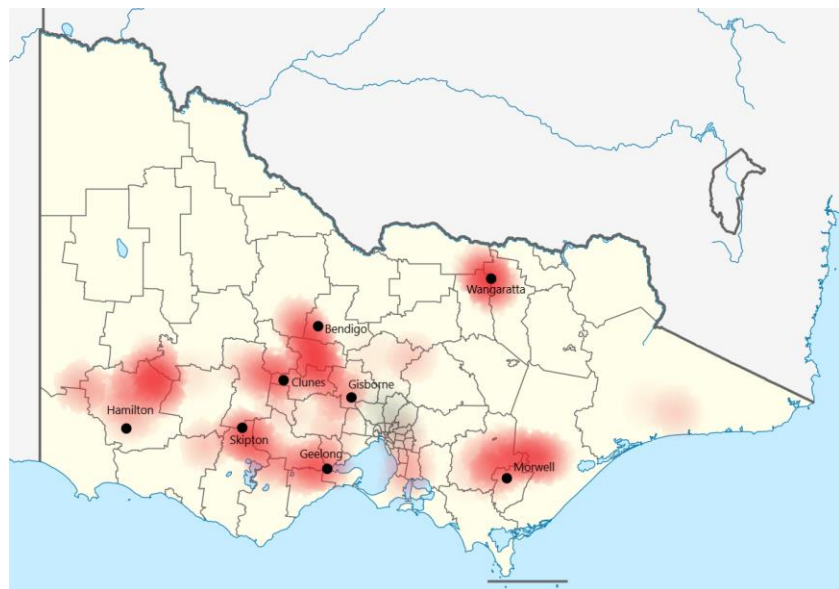
Figure 5: 1943-1944 Bushfires Map

Throughout this summer, a series of fires killed 51 people, injuring hundreds more and destroying over 600 buildings (FSMV Index). An added difficulty to this dry summer was the fact that many fire service workers and volunteers were overseas fighting in World War II.

The first large fire of the 1943-1944 bushfire season was known as the Wangaratta Fire. On December 22nd, 1943, a grass fire began to burn 19 kilometers outside of Wangaratta in the small town of Tarrawingee. With limited resources to extinguish the flames, fires burned down the town of Tarrawingee in a matter of only two hours. This tragedy left 10 firefighters dead and 63 homes destroyed (Another Bushfire Victim Dies, 1943). Many citizens were left homeless as thousands of hectares of grasslands were burned. In total, the fires of Wangaratta cost the local communities AUD 60,000 in damages.

As dry summer conditions continued, bushfires continued to erupt. Between January 8th-16th 1944, a series of fires were storming across the state of Victoria. On January 8th, a fire with a ten-kilometer front was sparked in Clunes and spread quickly, destroying 21 homes and a hospital. At the same time, a second fire in Wangaratta burnt 12,000 hectares, destroying about 20 homes. These fires took several days to put out, and before anyone had time to recover, another set of fires devastated large areas of the state about a week later.

January 14th marked another difficult day for the state of Victoria when fires were once again burning in the Central and Western Districts as well as in the Morwell and Yallourn areas. In total, 31 people lost their lives and over 700 homes were destroyed. The direct financial cost of these fires stood higher than AUD 2 million and there were major loses in livestock (FSMV Index).

The devastation caused by these fires led to the creation of the world's largest volunteer firefighting organization; the Country Fire Authority.

2.6.7 1961-1962 Bushfires

In the summers of 1961 to 1962, bushfires raged for days in the Dandenong Ranges. This mountainous area of Victoria is one of the most fire-prone areas in the world because of its mountainous topography, highly flammable vegetation, high wind speeds,

Figure 6: 1961-1962 Bushfires Map

and climatic patterns perfect for fires (Griffiths, 1992). From the 14th to 16th of January in 1962, fires burned so intensely in the Dandenong Ranges that the neighboring communities of Essendon and Moorabbin were forced to close their airports due to thick smoke plumes (Griffiths, 1992). These were the first major fires to be reported on live television in Australia. Mass hysteria ensued due to the public broadcasting in the nearby city of Melbourne where thousands of inexperienced volunteers traveled to the hills to offer their assistance. Although the CFA was forced to turn away many of these volunteers, they successfully extinguished the fires just 19 kilometers from Melbourne's city center. In total, 33 deaths were recorded and 454 buildings were destroyed (Bushfires in Our History, 1851 - 2009).

2.6.8 1965 Bushfires

Throughout the first three months of 1965, three notable bushfires took place in Victoria. The first of these fires occured on January 17th due to very hot temperatures (over 40 degrees Celsius), burning land in Longwood, Victoria. Collectively, the losses amounted to over 24,300 hectares burned, seven human fatalities, and substantial damage to local houses, barns, bridges and railway sections (FSMV Index).

The second notable 1965 fire occurred in Inglewood on the same day where an additional 8,900 hectares were burned. A fireman was killed in an attempt to fight the fire, with an additional 3,000 cattle being killed as well (FSMV Index).
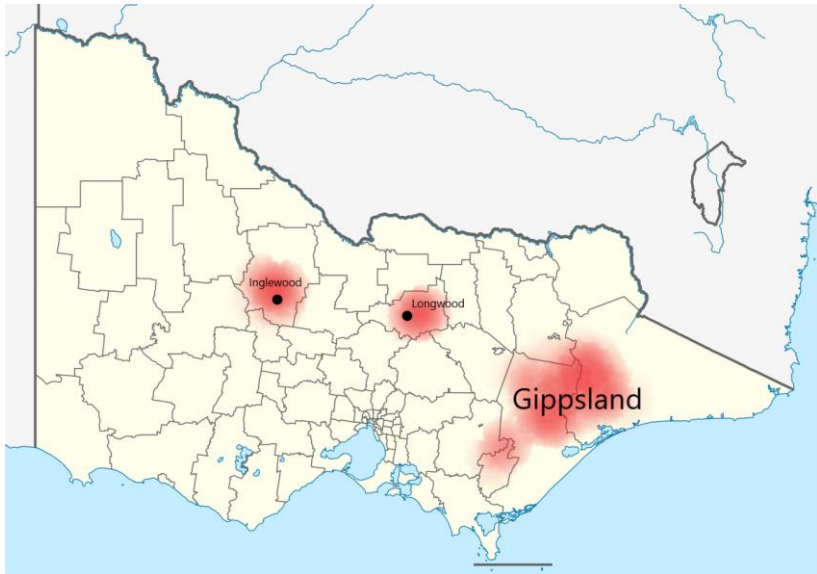
Figure 7: 1965 Bushfires Map

The final major fire in 1965 was the Gippsland fire, which raged from February 21st to March 13th for a total of 17 days. Losses included 82 buildings, 181 cattle, 3,100 sheep, and 500 poultry. Over 16,000 hectares of grassland and 303,500 hectares of forest were burned, with many motor vehicles and bridges being destroyed (FSMV Index).

2.6.9 Lara Fires – 1969

On January 8th, 1969, lack of summer rain caused over 280 fires to start around the state of Victoria. Due to wind speeds of 119 km/h, 21 of these fires developed into major bushfires, resulting in the burning of 250,000 hectares, affecting areas of Lara, Daylesford, Bulgana-Dunworthy, Yea/Alexandra, Darraweit Guim, and Kangaroo Flat (Bushfire Education Foundation, 2014, Duncan, 2016). In total, 251 buildings, 14 miles of railways, 12,000 livestock,
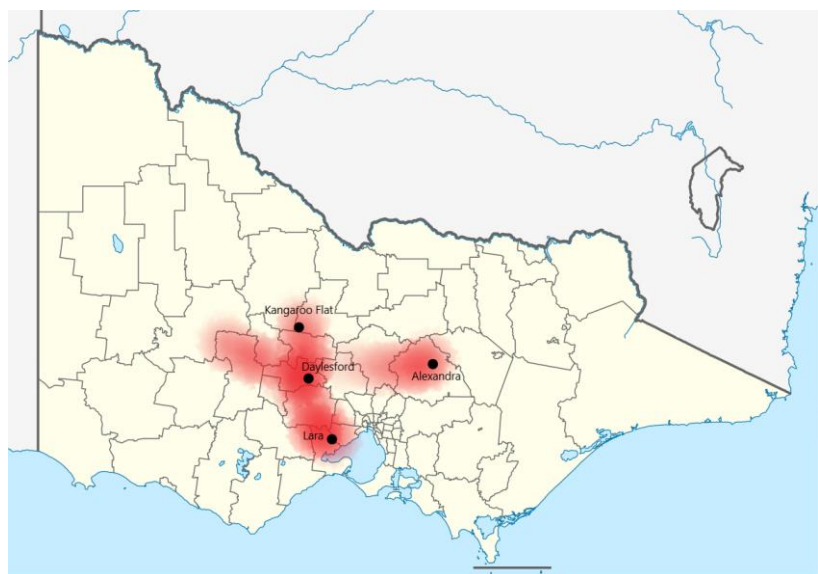
Figure 8: Lara Fires Map

and 23 lives were claimed by the fires. In just 1 hour and 15 minutes, the township of Lara was almost completely decimated, with 18 of the fatalities occurring in Lara alone (17 of those on the Princes Highway) (Duncan, 2016). Freelance TV news cameraman Barry Thomas was covering the Lara fires until an abrupt wind change caused the out-of-control bushfires to change front, forcing Thomas to retreat with firefighters to safety. After returning to the devastation minutes later, Thomas commented, "The smoke hadn't cleared, and when it did there were just people lying around there, burnt to death, because they got out of their cars. They just stopped when the smoke became too great because they couldn't see, they ran and then the fire came in and took them out" (Duncan, 2016).

Emergency Management Commissioner Craig Lapsley said dozens of people were caught on Princes Highway in thick smoke and 40°C heat when the wind swung around. Most were unaware of the fire conditions and riding with the windows down, as many cars in 1969 did not have a radio or air conditioning. Lapsley said individuals left their cars "because staying in the car was untenable... and they were forced to leave" (Duncan, 2016).

The disaster at Lara changed how fire agencies instructed motorists to behave, should they be caught on the road by a fire. Today, drivers are advised to park away from brush on open ground, or behind a barrier, and to huddle low under a woollen blanket, with the vehicle's lights and hazards on, facing the fire front (Duncan, 2016). The Lara fires also highlighted the importance of bushfire education. Due to the preventable nature of the Lara deaths, the aforementioned cameraman Barry Thomas was inspired to establish the Bushfire Education Foundation, through which he discusses the risk posed by fires in public forums and with school students (Duncan, 2016).

2.6.10 Ash Wednesday - 1983

Some of the most devastating fires to occur in Victoria were the Ash Wednesday bushfires. Prior to the start of the blazes, a heat wave and a 10 month drought occurred, allowing fires to move rapidly. On the day of the fires, temperatures rose up to 43 °C, humidity levels were less than 15%, and winds soared up to 100 km/h (Hall, 2017). The fires first started on the morning of February 16th, 1983 in Adelaide due to clashing power lines and deliberately lit fires (Country Fire Authority, 2011). Although the intensity of the fires were contained within two to

eight hours, Ash Wednesday resulted in the most loss of life from bushfires prior to Black Saturday; killing 75 and injuring hundreds more. The blazes were widespread, burning 400,000 hectares in total between Victoria and South Australia. There was a total of 180 fires with more than 100 in Victoria.

The area of Victoria with the most fatalities from the fires was Beaconsfield due to a sudden wind change causing 21 fatalities and 238

Figure 9: Ash Wednesday Map

destroyed houses (Country Fire Authority, 2011). A majority of the Beaconsfield fatalities were firefighters (Hall, 2017).

The destruction from the fires left AUD 400 million in damages in 1983. When converted to prices in 2015, the costs go over AUD 1.2 billion. More than 3,000 properties were destroyed. The damage on livestock was high as 340,000 sheep and 18,000 cattle died (Hall, 2017).

After the Ash Wednesday disaster, a review of fire safety was conducted and power lines were determined to be sources of fires. The power lines that were considered at risk of causing any fire were then reinsulated for safety. Another result of the fires was that the Government of Australia found the communication methods of the fire departments to be inadequate, thus the Government radio network (GRN) was created to ensure clear and effective radio transmissions in the case of an emergency (General Network Information). Meteorologists at the Bureau of Meteorology also adapted their practices to better predict wind shifts to ensure firefighters are not trapped in unpredictable wildfires.

2.6.11 The Linton Bushfire - 1998

In Linton, Victoria on December 2 1998 winds transformed the smoldering remains of burnt rubbish into a formidable fire. It was a typical summer day with the temperature around

30℃, humidity at 20%, and winds from 45-75 km/h (The Courier, 2002). Only 660 hectares of land was burned, however a sudden wind change caught the dispatched CFA firefighters of the Geelong West tanker off guard (Rees, 1998). Although they continued to fight the blaze, the five volunteer firefighters tragically perished in the flames that were not extinguished until the following morning.

Figure 10: Linton Bushfire Map

2.6.12 The 2003 Campaign Fires

The 2003 campaign bushfires occurred in the northeast region of Victoria and spread to New South Wales. The bushfires started due to lighting strikes sparking over 100 fires which lasted from January 9th, 2003 to March 7th, 2003, for a total of 59 days (CFA, 2003). While the area burnt was mostly forest and mountain regions, the main objective of firefighters was to prevent the blazes from spreading to populated areas. In total, 3,239 fires erupted throughout Northeast Victoria. To fight the flames, 55 strike teams, 8,600 CFA personnel, and over 6,000 firefighters were needed. More than 40 houses and 9,000 cattle or sheep were lost in the fires, however there was no loss of human life. A total of 1,127,452 hectares were affected; amounting to 5% of Victoria's territory (CFA, 2003).

Figure 11: 2003 Campaign Fires Map

2.6.13 The 2006 Campaign Fires

The 2006 campaign bushfires, also known as the Eastern Victoria Great Divide or Great Divide Complex bushfires, occurred in the northeast region of Victoria due to lighting strikes sparking fires in the Victorian Alps. Similar to the 2003 Campaign bushfires, the area burnt was mostly forest and mountain regions. These fires were the longest burning bushfires in Victoria's history, lasting from Dec 1st, 2006 to Feb 6th, 2007 for a total of 69

Figure 12: 2006 Campaign Fires Map

days (Community Bushfire Connection, 2006). Although the bushfires did not cause any direct loss of life, a total of 1,154,828 hectares was burned, destroying 33 houses and killing over 1,300 livestock (Community Bushfire Connection, 2006).

2.6.14 Black Saturday - 2009

The summer of 2009 was one of the hottest and driest summers recorded in Australia. In the days leading up to the fires, John Brumby, the Premier of Victoria, warned the citizens of the potential for bushfires as the weather conditions were forecasted to be the worst fire conditions in history (Whittaker, 2013). The people of Australia prepared for the fires by following the Stay and Go Policy. Each person was encouraged to protect their house, or leave before it was too dangerous to do so (Connick, 2010).

The fires started on February 7th, 2009 when the state of Victoria suffered from a heat wave of 41°C (National Museum Australia). The first fire started when strong winds brought down power lines that caused sparking in the Kinglake/Whittlesea area in Victoria. Several other fires started in the state of Victoria, one of which was caused by two children in Bendigo after accidental burning (National Museum Australia). That day, 47 major fires burned across the

state. These fires became even more destructive when winds at the speed of 90 km/h brought them closer together. 400 individual fires erupted by evening time (National Museum Australia). Hot, dry conditions continued and despite the concerted efforts of more than 19,000 Country Fire Authority members, the fires continued to blaze for weeks until rainstorms, fuel reductions, and human intervention (including fire trucks, helicopters, and fixed-wing aircrafts) eliminated the bushfires (National Museum Australia, Sandri, 2009).
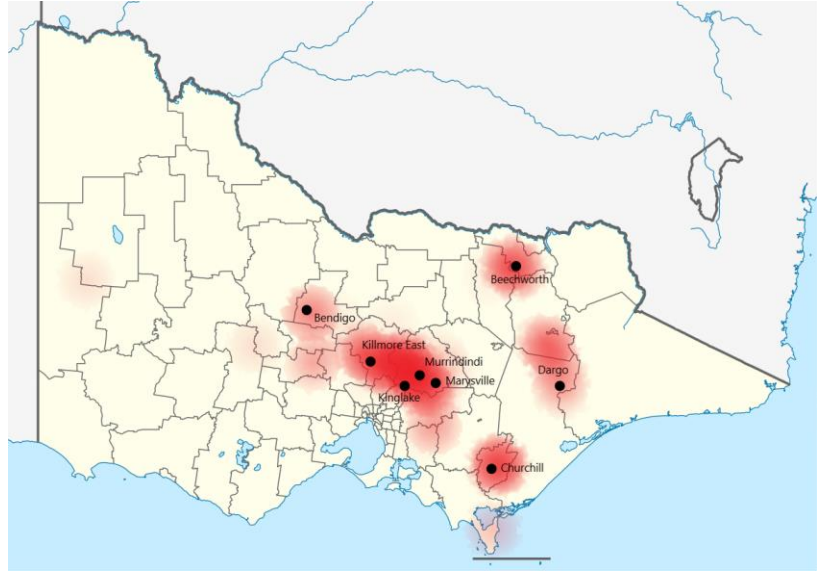
Figure 13: Black Saturday Map

The Black Saturday fires were the most devastating fires in Australia's history, killing 173 people and injuring 414 (Australian Institute of Criminology, 2017). Police reports indicated that 113 of the people who died had stayed to protect their house (Whittaker, 2013). Thus, the Victorian government revised the policy and enacted the Prepare, Act, and Survive Policy in July 2010 (Teague, 2010). The tragedy caused by the bushfires forced Premier Brumby to announce a Royal Commission. The Commission was tasked with investigating the nature of circumstances surrounding the Black Saturday bushfires. This resulted in developing 67 recommendations, which included modifying building codes, revising the Victorian Government's methods for bushfire preparations and education policies, and banning construction of homes in high-risk areas (National Museum Australia). In addition, the Supreme Court of Victoria sued SP Ausnet, the company who owned the power lines that caused the fires, for AUD 494 million in court and an out of court settlement for AUD 300 million (National Museum Australia).

In comparison with the Black Friday fires, less land burned, but more loss of life and destruction occurred. A total of about 450,000 hectares of land burned. Over 3,500 buildings with more than 2,000 houses burned down. More than a million wild and domesticated animals died in the fires (National Museum Australia).

2.6.15 Saint Patrick's Day Fires - 2018

One of the most recent Victorian bushfires occurred on Saint Patrick's Day, March 17th, 2018. Prior to that weekend, the weather conditions were predicted to be so fire-prone that there was a total fire ban the following Saturday. Craig Lapsley, the Emergency Management Commissioner for Victoria, told the public that the "weekend would test us" (Lovell, 2018). It was late Saturday night, around 9 pm, when the fires started due to lightning strikes, as well as strong winds that reached a speed of 104 km/h and took down power lines. Fires burned throughout the Southwest region of Victoria and lasted three days. Some of the regions where the larger fires burned include Terang Substation, Princes Highway, Camperdown, Garvoc, and Gazette. The fires near Terang Substation (where electricity is converted to lower voltage for communities to use) started due to power lines clashing, causing molten metal to fall onto the ground and spark fires. The fires continued to burn from Terang Substation and moved along Princes Highway. In Camperdown and Gazette, tree limbs fell onto power lines and caused sparking. High winds took down an electricity pole and sparked fires

Figure 14: Saint Patrick's Day Fires Map

near Garvoc. Hundreds of firefighters responded with several aircrafts and firetrucks.

The destruction from the fires resulted in the loss of 24 homes, 57 sheds, and 10,000 livestock (Lovell, 2018). More than 800 people fled to relief centers to get away from the destruction. Citizens of Victoria that could not make it to relief centers slept in their cars away from the fires. A total of 40,000 hectares of land was devastated, and despite all of the damage, no lives were lost.

2.7 Formation of the Country Fire Authority

The Royal Commission of 1939 gave several recommendations relating to the operations of the fire services in Victoria and fire safety. The Black Friday bushfires of 1939 took place during the outbreak of WWII, thus, those recommendations were not put into place as it was not the main concern at the time. After the devastating summer of 1944 the Victorian State Government was determined to enforce the recommendations given in 1939 and establish a more efficient fire management system.

2.7.1 Fire Services Prior to 1944

Prior to the summer of 1944, the fire services in the state of Victoria were split between three organizations: The Metropolitan Fire Brigade Board (MFBB), the Country Fire Brigade Board (CFBB), and the Bush Fire Brigades. The MFBB was in charge of the operations within the city of Melbourne, while the CFBB oversaw the fire brigades in towns 16 km outside of the city. Meanwhile, the Bush Fire Brigades consisted mostly of local landowners who received little to no financial assistance from the Government and operated independently from their urban counterparts (History Timeline, 2017).

These three organizations lacked coordination. For example, there was no central control over when the burning of fire breaks was safe as the efficiency of fire breaks depends on weather conditions and the locations of the fires (a fire break is gap in vegetation or other combustible material that acts as a barrier to slow or stop the progress of a wildfire). In addition, there was no central body controlling the Bush Fire Brigades across the state, and warning systems were not sufficient (Gamble, The Beaumaris Bushfires of 1944).

2.7.2 Bushfire Brigades

The first bushfire brigades in Australia were formed in the state of Victoria in the early 1900's. On the 5th of January, 1901, *The Australasian* reported that residents had organized and equipped bushfire brigades as there had been a concern with "a prolific growth of grass and crops". Over the next several years, more brigades formed across Victoria. After WWI, soldiers

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that were accustomed to strict military organization saw the advantages of organized brigades and often took charge in creating them (Murray, & White, 1995).

Throughout the 1920's, bushfire brigades were still informal and operated on a volunteer basis. During this time, the idea to create a statewide organization that would oversee the bushfire brigades originated. On September 19th, 1928, this idea became a reality and the Bush Fire Brigade Association was formed. The association was controlled by a central committee that oversaw brigades from seven districts across the state.

Over the years, the association was able to advance the brigades on an organizational level, however, it was still not able to convince the government to provide financial support. It wasn't until the disastrous summers of 1939 and 1944 that the bushfire brigades were formally unified under a single operating body (Murray, & White, 1995).

2.7.3 Country Fire Authority

In 1944, the Victorian government announced the formation of a new organization, the Country Fire Authority (CFA). The Country Fire Authority was established as the coordinating body for brigades beyond the jurisdiction of the Metropolitan Fire Brigade. The CFA is still operative after more than seventy years, providing a diverse range of risk reduction, fire suppression and incident management services to minimise the impact of fires and other emergencies on Victorian communities (Murray, & White, 1995).

2.8 Evolution of Australian Firefighting Technology

The evolution of firefighting technology in Australia removed many of the burdens which accompanied firefighting equipment. In the early 1900's, firefighters wore metal conductive helmets which were dangerous as many fires involved exposure to high voltage electricity. Early gas masks inhibited firefighters from simple movements as they consisted of air being pumped from bellows through a hose to a bulky face mask (Fire and Rescue).

Since 1985, widespread modern helmets have been made of polymers and plastics. These helmets are non-conductive, lightweight, and contain a built-in spring-loaded eye protection visor that can be deployed quickly by the user. Gas masks are now self-contained and provide

service workers with up to 30 minutes of clean air (Fire and Rescue). Although many improvements have been made, the leading cause of firefighters' onsite injuries is due to bulky and poor fitting gear. 3D motion sensor technology and 3D printing have allowed researchers to analyze which firefighting equipment needs to be updated (Cutler, 2013) .

Drone technology offers exciting new advances in how Australian fire service members deal with wildfires. Before 2016, firefighters used to fight wildfires up close, in the "danger zone". Today, with drone and programming advancements, firefighters can view a fire from aerial drone footage (FSMV Index). Reducing the time that firefighters spend in the "danger zone" is essential to firefighting safety. Drones can even be equipped with thermal cameras to see where certain hotspots burn as these areas present the most challenges when extinguishing. *Australis*, a new interactive wildfire simulator, can predict the direction and intensity of bushfires before firefighters even attempt to enter the "danger zone" (Fire and Rescue). With these new technologies, firefighter injuries and deaths can reduce greatly.

2.9 Facilitating a Sensitive Interview

The following section discusses information regarding facilitating a sensitive interview prior to and throughout its execution. The strategies were used throughout the interview process, especially with interviews discussing potentially emotional information.

Speaking on sensitive topics can cause great emotions in those affected by traumatic events. When talking to an interviewee, there are some techniques which can help elicit sensitive topics. In many instances, regular talk will not make the participant feel comfortable enough to share sensitive and relevant information. The topics discussed can cause high stress and bring out PTSD in some individuals. Some of the techniques we used to account for these issues include developing rapport, using small talk, and demonstrating care and empathy (Elmir, 2010). Establishing rapport between the participant and interviewer can be achieved by opening up to each other and building a trusting relationship. Demonstrating care and empathy can be expressed merely with eye contact and reacting to what the participant says in a positive manner (Elmir, 2010). The idea is to make the participant feel comfortable sharing personal information about himself/herself. An uncomfortable interviewee will offer little or no information. Always allow the participant time to process feelings by remaining silent in times when he/she is

expressing himself/herself (Elmir, 2010). In using these techniques, our interviews more accurately captured the participants' experiences and emotions.

To prepare for the sensitive interviews we would be conducting with firefighters who had been on duty during a bushfire, our group met with Albert Simeoni, a professor and interim department head of Fire Protection Engineering at Worcester Polytechnic Institute. With over 10 years of firefighting service experience in Europe, Professor Simeoni provided us with valuable information on what firefighters experience during and after wildfire disasters. One particular topic Professor Simeoni discussed is the aftermath of wildfires. After a large fire occurs, fire service members walk through the burnt land to offer support to anyone left behind during the disaster. During this time, many fire service members see horrifically burned victims and other extremely disturbing sights. In addition to these traumatizing sights, firefighters could have also lost a fellow partner, family member or friend during these fires (Simeoni, 2018). When going into each interview with a firefighter from a devastating fire, we must be sensitive to the possibility they may have seen or experienced trauma. We attempted to construct a comfortable setting by conducting the interviews in a private location, allowing the interviewee to tell us what they wish, and not create any pressure to share information that would bring out negative emotion or past traumas.

2.10 Interactives in Museum Exhibitions

The Fire Services Museum of Victoria has requested the presence of an interactive timeline to represent some of the bushfire data collected both online and locally for the exhibit. Since the interactive timeline is one of the core components of the exhibit, it is essential to understand how to develop an interactive display which is historically accurate and appealing to a wide range of individuals. Interactive exhibits are prevalent in numerous locations ranging from children's museums to internationally-renowned museums of science, including the Smithsonian (Pekarik, 2002). These exhibits appeal to a wide variety of audiences because of their ability to both physically and intellectually stimulate a wide scope of visitors (Pekarik, 2002). Participants in a Smithsonian study on interactives describe them as "An exhibition feature that encourages physical participation on the part of visitors. I don't consider audio or video devices to be interactive unless they are played on demand by visitor action." and

"Something that brings to the experience more than just visual information. An interactive can be touched, smelled, felt, heard, or manipulated in some way and provides some kind of information or invokes feelings that cannot be had by simply viewing a thing." (Pekarik, 2002). Other studies have also found that visitors are more motivated to find meaningful and personal connections to artifacts or exhibits without relying solely on simple curators or exhibit labels (Alelis, 2013). The Smithsonian study further determined that interactive exhibits stimulate visitors intellectually and emotionally, promoting deeper involvement with the subject (Pekarik, 2002).

Overall, wildfires can greatly impact a society, causing death, devastation, and loss. Through utilizing displays and an interactive timeline exhibit which incorporates wildfire data and personal stories, we hope to develop an enticing display commemorating the bushfires and those affected.

Development of Anniversary Bushfire Exhibit

3.1 Mission/Goals Statement

The goal of the project is to educate viewers about the environmental and social effects of bushfires from 1851 to 2018 using artifacts, personal stories, and interactive activities while leaving an emotional impact on the audience. We acquired personal stories and implemented them into the exhibit by interviewing individuals with first-hand and second-hand accounts of bushfire events. Incorporating personal accounts adds a more emotional aspect to the exhibit. In addition, we included artifacts obtained by the FSMV to present the evolution of firefighting technology over the years. To educate visitors about the fires that occurred between 1851 and 2018 in the state of Victoria, we developed iPad-based interactive timelines to present the information and impact of Victorian bushfires.

3.2 Investigating a similar interactive exhibit at the Worcester Art Museum

Our team visited the Worcester Art Museum to investigate how museums design their exhibits and display relevant information to their visitors. One exhibit at the Worcester Art Museum contained an interactive iPad where the user could sift through videos and pictures related to the display. Originally, the FSMV intended to use a laptop for the interactive timeline, but after using the iPad at the Worcester Art Museum, we noticed that a touch screen offers a more user-friendly experience. Thus, upon our arrival to the project center in Melbourne, we concluded with our sponsor that it is best to use an iPad for the purpose of our project. In addition, we noticed the interactive component at the Worcester Art Museum was too confusing for those not as adept with technology, as transitions within the software were too complicated, making it easy to get "lost" within it. We created the timeline with the user in mind, allowing for simple transitions between videos and pictures without being overwhelmed or "lost" among the quantity and variety of information.

3.3 Ensuring the project maintains continuity with the pre-existing museum exhibits

To ensure that our exhibit represents the FSMV in the most effective way, we interviewed museum personnel regarding the museum's themes, visitors, and current exhibitions. Questions were developed which relate to the exhibit's expected audience, as well as which features we could incorporate into the project's display. A list of these questions can be found in Appendix A subsection 2.

These results gave us insight into how and why the current Fire Services Museum exhibits are popular. We also saw what aspects of the FSMV volunteers find valuable to incorporate into the timeline exhibition.

3.4 Obtaining personal bushfire accounts

We interviewed firefighters in order to help visitors understand the difficulty of firefighting in Australia. Through these interviews, we studied the short-term and long-term effects firefighting had on the firefighters. The stories we gathered through the interviews are presented in our exhibit through quotes that include personal accounts from fires, as well as the firefighters' thoughts on the different aspects of their job. These quotes aim to make our exhibit more compelling and personal to the visitor. A list of the specific questions we asked firefighters to get a better understanding of their lives, and how bushfires impacted them, can be found in Appendix A subsection 1.

3.5 Exhibit Topics

After conducting research and consulting with the staff of the FSMV, we determined that including the following topics in our exhibit will provide the most educational value to the visitors.

Displays:
- How Bushfires Start and Spread - This section provides basics knowledge on why bushfires are so common in Australia, and will teach visitors on the factors that firefighters need to take into account when fighting a bushfire.

- Evolution of the Fire Services in Victoria - As we created the interactive timeline, we learned that the fire services in Victoria went through many changes over the years. Thus, we determined that this section will provide context on how Victorians fight fires. In addition, this section will fit very well with the firefighting artifacts we incorporated in the exhibit.
- Peer Support - Many people are knowledgeable of the tasks a firefighter performs, but most are not aware of the hardships this job entails. It was essential for us teach visitors about the psychological trauma many firefighters experience on a daily basis, and discuss the support program that was put in place to assist them.
- Black Friday (1939) and Black Saturday (2009) - One of the main objectives of this project was to create an exhibit in memory of those affected by the Black Friday and Black Saturday fires, thus, we created a display dedicated to those fires.
- Social Impact - Bushfires affect Victorian communities on a yearly basis, both on an individual level and a communal level. This section provides information on the impact bushfires have on people, and how Victorians stay prepared ahead of these disastrous events.

Timelines:
- Bushfire Timeline - The information present in the "Bushfire" timeline consists of textual data and pictures regarding the 15 most impactful bushfires to occur in Victoria. This includes textual information, as well as maps, images, and depictions of Victorian fires between 1851 and 2018

- Personal Accounts Timeline - The information present in the "Personal Accounts" timeline includes videos, pictures, and stories relating to bushfires and those who experienced them. All information is sorted chronologically, yet this timeline contains a variety of media that can relate to specific bushfires, such as Black Saturday, or bushfires in general.

3.6 Planning and Developing Interactive Exhibit Components

In order to fulfill the project's objective of eliciting an emotional response from the visitors, while also creating an attractive and historically accurate exhibit, we developed an interactive timelines using the BEEDOC's *Timeline 3D: Education Edition* app software for iPad. *Timeline 3D* allows for the chronological organization of events and videos, as well as a touch-based interface.

In developing the interactive timelines, we integrated both personal accounts, as well as bushfire data collected throughout our research. Bushfire information was collected from the Victoria State Library and the FSMV's informational records. The bushfire information includes the fifteen major Victorian fires, as well as relevant personal accounts and stories from each of those fires. Our exhibit consists of two different timelines. One timeline contains the factual information about the bushfires, and the other contains recorded personal accounts of the fires. While this information was originally planned to be within a single timeline, we concluded that it is best to split the information between two devices. After using the software and getting feedback from our sponsor, we decided that separating the major bushfire information from quotes and videos would provide a more fluid and simplistic experience for the user. This allows visitors to read the information that is more relevant to their interests without feeling "lost" in navigating the timelines. In addition, both timelines contain textual references to one another to allow visitors to cross-reference information between the iPads. For example, the bottom of the Black Friday timeline entry reads: "To read personal stories and watch videos from the Black Friday fires, refer to other iPad."

We used an iterative approach consisting of three main steps to develop each timeline as follows:

- Site Assessment: Understanding the size, themes, and limitations that impact the timeline creation. This also involved formulating a timeline design that is appealing and representative of bushfire themes.
- Design Development: After compiling the information required for the timeline's data, we created the functional representation of the timeline's user interface and composition. An initial demo was created to show the overall feel and organization of the events and audible stories.

- Iterative Prototyping: After specifying the organization and physical interface of the application, the timeline was fully developed using the *Timeline 3D* application. An original prototype may not be fully representative of all the final desired features or interactive feel, so it was developed in an iterative fashion: developing multiple versions until the team and sponsor believed the timeline was satisfactory in representing the project goals and expectations.

3.7 Exhibit Artifacts

To present the evolution of firefighting technology over the years, we incorporated artifacts to our exhibit. The artifacts we chose are: an old leather hose, a modern rubber hose, an old metal nozzle, a modern plastic nozzle, an old CFA helmet, a modern CFA helmet, an old fire extinguisher, a hessian beater that was used to put bushfires out, an old gas mask, and a modern gas mask. In addition, our group compiled a collection of newspapers that consist of articles from the day of the fires, photographs, and anniversary events. The fires included are Black Thursday, Black Friday, Wangaratta (1943), 1962 fires, 1965 fires, Lara fires, Ash Wednesday, 2003 Campaign fires, 2006 fires, Black Saturday, and Saint Patrick's Day fire. All the newspapers were obtained through the FSMV's collection and combined into two binders. The Black Saturday fires have a binder dedicated to them due to the impact of the fires and the large amount of articles in the FSMV collection on this event. The two binders are displayed in the exhibit on a table for visitors to easily view.

3.8 Determining Exhibit Layout

To determine the layout of our exhibit, we created a 3D model of the room our exhibit using the software application, *SolidWorks*. This allowed us to test what is the most effective way to display the exhibit. Since the exhibit will be moving between different locations across Victoria, many of which might not have the option of wall hanging, it was essential for us to provide a secondary way to present the displays. Thus, we constructed three double-sided stands,

allowing two displays to be hung on each stand. The display stands can be deconstructed quickly, allowing it to fit in an average-sized car for easy transportation.

We previously determined that our exhibit consists of five displays. In planning the standing display configuration of the exhibit we noticed that, with only five displays, one stand would have no backing. We concluded that for aesthetic purposes, it is best to create a sixth display. This sixth display would only consist of additional bushfire pictures to provide a more aesthetically pleasing stand backing.

To allow for the exhibit to be displayed in a variety of locations, the Anniversary Bushfire Exhibit was created to be configurable to any room size. The displays can be hung on the wall or set up as three double-sided standing displays. The iPads have their own metal stands, and are intended to be positioned in front of the displays.

Exhibit room at FSMV:
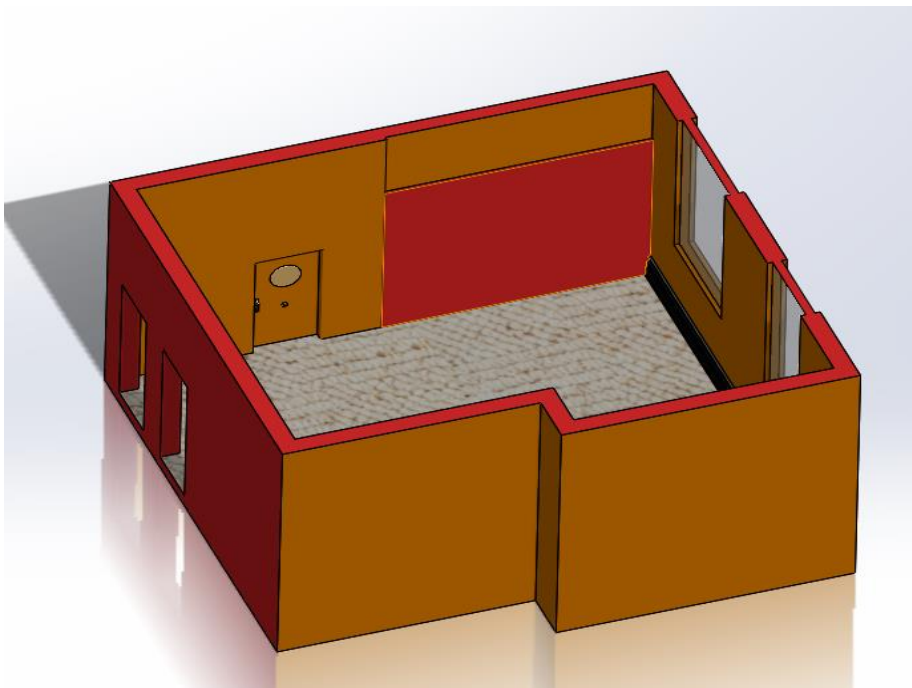
Figure 15: Exhibit Room Model

First iteration layout of displays hanging on the wall and on stands:
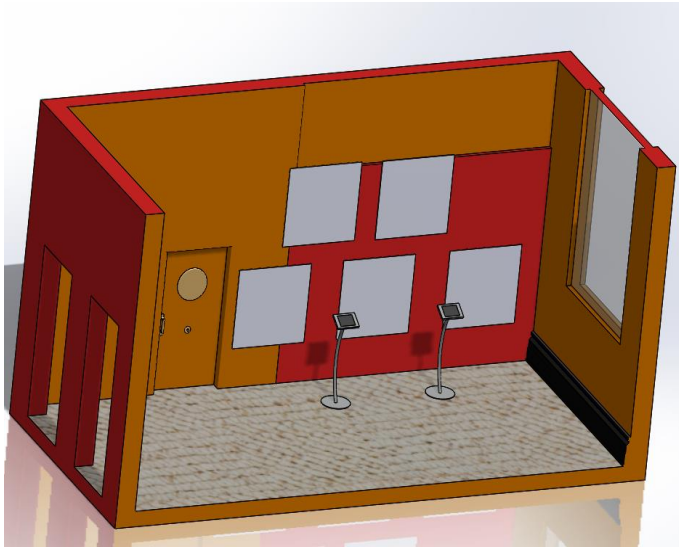
Figure 16: First Iteration of Wall Hanging Configuration

Figure 17: First Iteration of Traveling Displays

Second iteration of exhibit in Fire Service Museum:
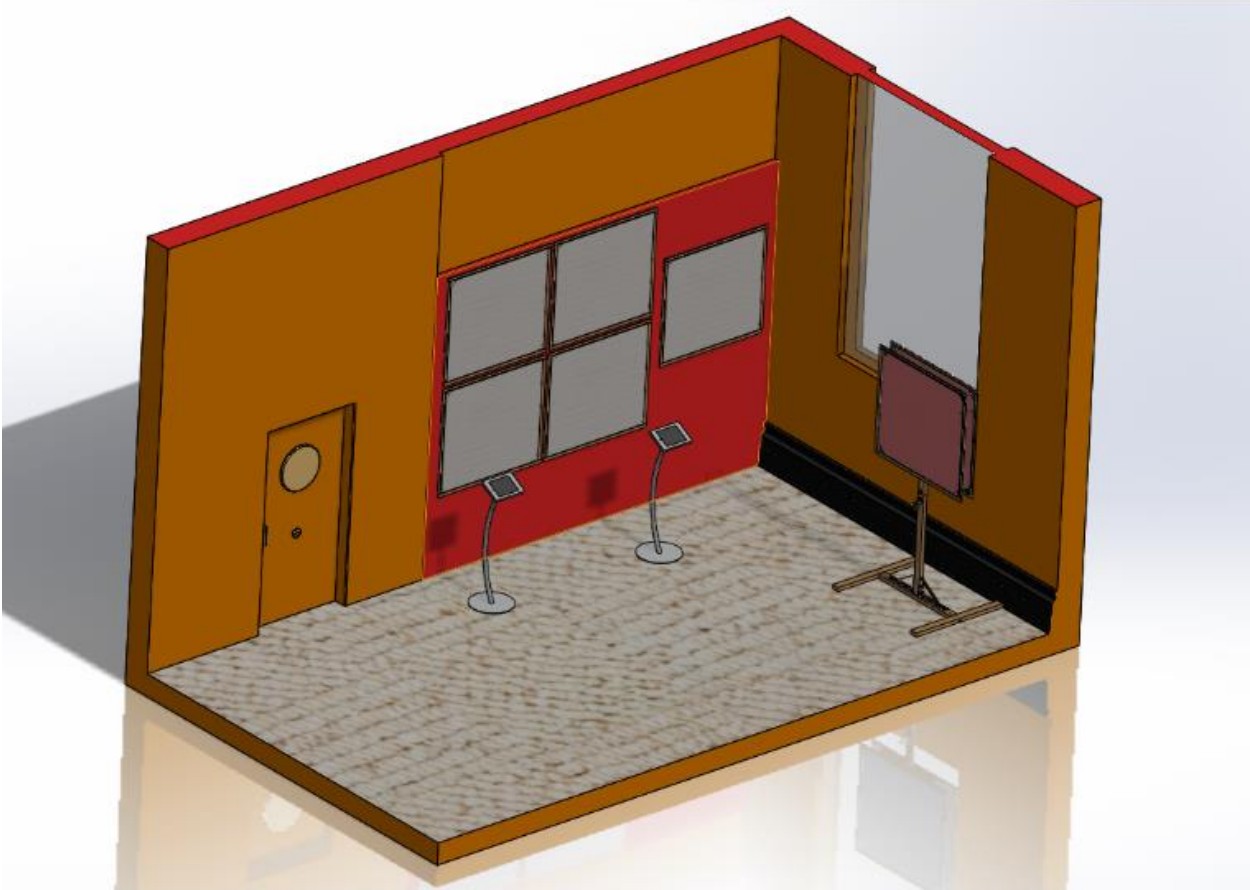
Figure 18: Second Iteration of Wall Hanging Configuration

Stand Design:

Figure 19: Portable Stand Model

Display frame model:
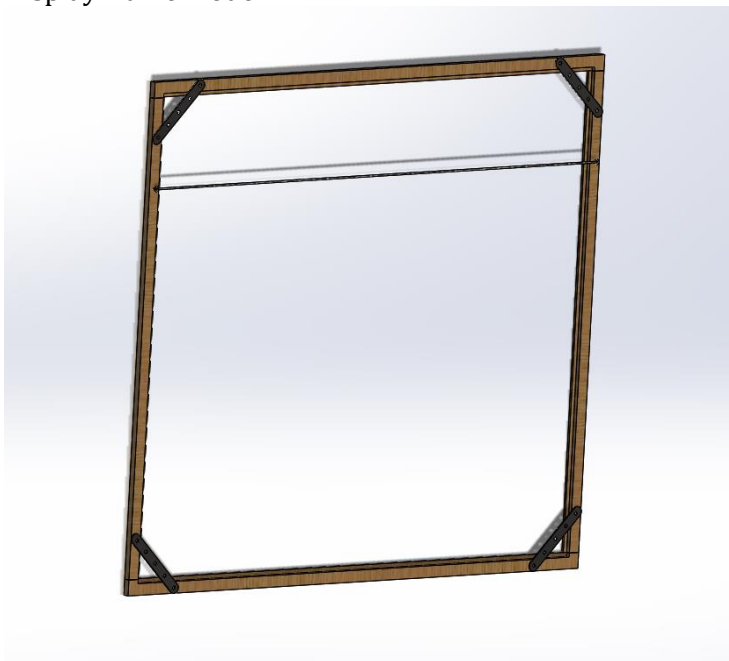
Figure 20: Display Frame Model

Potential display set up outside of FSMV:
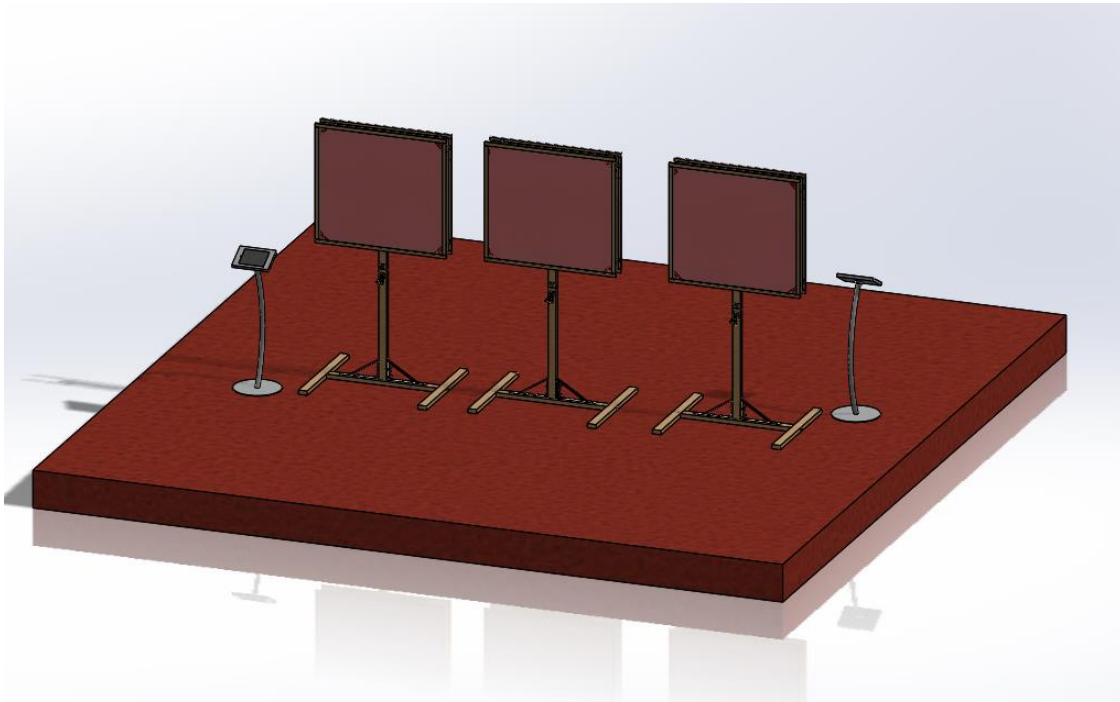
Figure 21: Outside Display Setup Model

3.9 Writing an Instruction Manual Detailing the Exhibit's Transport and Assembly

       The FSMV plans to present the exhibit in different locations around Victoria. To provide a more fluid transition and assembly process, we wrote an instruction manual explaining how to properly move and construct the exhibition. The manual was created based on the materials used to construct the exhibit. Instructions on how to operate the interactive timelines and setting up the technical components are also incorporated into the manual. The finished version of this manual can be found in Appendix B.

Results

4.1 Printed Displays

      The following displays are printed on 200gsm paper and mounted on 5mm foam boards. The dimensions of the each display are 36 inches by 40 inches (91.44 cm by 101.6 cm). In addition, we made a wooden frame for each display, making it easy to hang on a wall as well as the portable stands we constructed.

Figure 22: How Bushfires Start and Spread Display

PEER SUPPORT

"There are jobs where it never gets any easier to see people's homes destroyed, loss of life, it's absolutely horrible"– Firefighter

"It was a major forest fire in an urban environment. 700 houses, two and a half thousand buildings burnt to the ground, gone, and there was just ash. In some places you couldn't have even known there was a building there."
–Firefighter speaking about Ash Wednesday

Ash Wednesday Impact

One of the most overlooked, yet impactful changes the Ash Wednesday fires had was the support system that was created post-fire. Before 1983, showing any signs of mental trauma or stress after an event was seen as a sign of weakness. Many people questioned if mental illnesses such as PTSD were even real. The Ash Wednesday fires opened many people's eyes to the real impact tragedies can have on a person's mental health.

In 1984, a program consisting of support staff was informally started to provide firefighters with a safe space where they could talk about the hardships they face on the job. Before this system was put in place, many firefighters avoided talking about any issues they were dealing with as they did not want to seem cowardly. This resulted in firefighters retiring, only to then deal with the onset of PTSD in the following years. The newly-formed peer support system that arose after the Ash Wednesday fires became an important structure for firefighters to lean on when they were in need.

"So, if we had been doing something earlier, talking about it instead of going back to the fire station and not talking to anyone, thinking, 'suck it up, it's the way life is, we're tough, I can deal with this on my own.' Ya, you can, but the bucket fills up and then you got to go and empty it somewhere. But you have to know how to empty it, where to empty it, who's going to help you empty it. Peer support, ahh, I could not speak more highly of the peer support system."
–Firefighter's thoughts on the early days of peer support

Peer Support Initiated

In 1992, a formal program of support was opened to assist fire service members. Initially, 12 volunteers served as peers, all equipped with pagers and remained on call 24/7 in case anyone needed to talk with them.

In the early stages, peers tried to change the way firefighters saw their support program by spreading the motto: "It's alright to not be alright." Firefighters were encouraged to talk to peers after any situation that could have a negative impact on their mental health. The proactive approach these peers displayed persuaded more and more firefighters to sit down and discuss their experiences. All information shared was kept in complete secrecy to ensure those with psychological trauma felt comfortable opening up to help.

Soon after 1992, the fire service community saw the popularity of the peer support system grow, and fewer firefighters were resorting to negative means of alleviating stress (such as alcohol, drugs, prescription meds, and isolation from family members and friends).

"I've worked around more of the periphery of peer support because I was never, never going to own up to what I was going through. I thought it would be seen as being weak. Once I did seek help, it was probably one of the best things I've ever done. I thought, 'wouldn't it have been such a good idea if I started this earlier.'"
–Firefighter's thoughts on peer support

Peer Support Today

Today, there are 85 peer members in the MFB (Metropolitan Fire Brigade), with 3 internal psychologists who are on call at all hours of the day. Unlike the earlier days of peer support, it is now a common practice for firefighters to seek help after a traumatizing experience.

Firefighters of both the MFB and CFA (Country Fire Authority) also serve as first responders to any situation referred to as "priority 0", meaning the victim is either unconscious or not breathing. As a result of this, many fire service members will witness graphic sights such as extreme injury or death. It's after these critical incidents that a peer member will reach out to the fire service worker to assess his or her mental state. Since everyone responds differently to trauma, each situation is handled in a manner that best suits that firefighter.

The peer support program extends beyond the active firefighters, providing assistance to their families as well as any retired fire service members. The success of the peer support program helps about 100 retired firefighters and their families every year, and continues to assist active members as they deal with traumatizing events.

"When it (peer support) came in, it was 'what's all this crap about,' but it has proven to have value. You go to a job, a road accident, a house fire with fatalities, any suicide type incident, when you have that sort of thing, it has an effect on you. It's hard to handle, and in the early days, we had nothing, you just sort of suck it up, but they started bringing in the peer support program. Now when we have a bad incident, they get together with us and talk it through with us.

Many people who thought they could handle what they saw realized that they did need peer support after talking with them.

With the peer support program, they talk to our families to watch out to see if anyone's acting a little strange and see if anyone needs additional help. I'm sure back in the day a lot of firefighters went off the rails or got depression badly because they had no help, they were concerned because if they asked for some help the rest of the brigade would say you're just being a sissy"
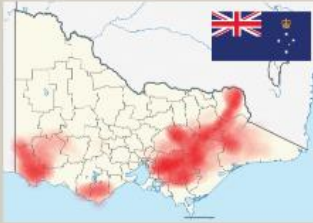–Firefighter speaking on peer support

Figure 23: Peer Support Display

BLACK FRIDAY 1939

COMMEMORATING THOSE WHO LOST THEIR LIVES 80 YEARS AGO

"But though they [citizens] felt the imminence of danger, they could not tell that it was to be far greater than they could imagine."
-Bushfire Royal Commission of 1939

"On that day it appeared that the whole State was alight. At midday, in many places, it was dark as night.... Travelers on the highways were trapped by fires or blazing fallen trees, and perished. Throughout the land there was daytime darkness."
-Bushfire Royal Commission of 1939

The Black Friday bushfires began on January 13 1939. In just two short days, 2 million hectares of land burned with 71 fatalities. The 6-8 weeks leading up to the fires were extremely dry, with humidity levels as low as 15 %. Like most bushfires, the Black Friday fires started mainly due to human causes. These causes included burning off for land clearing and grass growth, lighting campfires, inappropriate sawmill operations, and domestic fires. The fires moved through the mountains of Victoria in the northeast and down along the densely populated southwest coast. A much-needed rainstorm ultimately ended the fire.

In addition to the 71 human fatalities, thousands of sheep, cattle, and horses were lost to the fires. The bushfires burned down 69 sawmills and over 1000 homes. Of the 2 million hectares burned, 575000 were reserved forests.

The estimated cost of damage from the fires was reported to be about $750 million. As a result, the Victorian Government announced a Royal Commission led by Judge Stretton. Stretton's commission has been described as one of the most significant inquiries in the history of Victorian public administration, ruling seven major points of action. These recommendations related to forest management, fire safety, and the operation of the fire services in Victoria (which would ultimately create the CFA). Since the Black Friday bushfires of 1939 took place during the outbreak of WWII, those recommendations were not put into place as the war was the primary focus at the time.

"The speed of the fires was appalling. They leaped from mountain peak to mountain peak, or far out into the lower country, lighting the forests 6 or 7 miles in advance of the main fires. Blown by a wind of great force, they roared as they traveled. Balls of crackling fire sped at a great pace in advance of the fires, consuming with a roaring, explosive noise, all that they touched."
-Bushfire Royal Commission of 1939

In loving memory of the 71 people who passed away during the fires

BLACK SATURDAY 2009

COMMEMORATING THOSE WHO LOST THEIR LIVES 10 YEARS AGO

"It felt like an apocalypse, it was really scary we didn't know how close we were to the fire... they shut down the freeway because they didn't know how bad it would get... you couldn't see anything because the smoke was so bad."
-Firefighter

"We had people banging on the sides of our tanker begging us to go back to the house where they knew our people were trapped. But we couldn't because if we had, we'd all be dead too."
-Firefighter

The summer of 2009 was one of the hottest and driest summers ever recorded in Australia. The Black Saturday fires started on February 7 2009 when the state of Victoria suffered from a heat wave of 41°C. The first fires arose when strong winds brought down power lines that caused sparking in the Kinglake/Whittlesea area. That day, 47 major fires burned across the state. These fires became even more destructive when winds at the speed of 90 km/h brought them closer together. Over 400 individual fires erupted by evening time. Despite the concerted efforts of more than 19000 Country Fire Authority members, the fires continued to blaze for weeks until rainstorms, fuel reductions, and human intervention (including fire trucks, helicopters, and fixed-wing aircraft) eliminated the bushfires.

The Black Saturday fires were the most devastating fires in Australia's history, killing 173 people and injuring 414. A total of 450000 hectares of land burned, destroying 3500 buildings. More than a million wild and domesticated animals died in the fires.

The tragedy caused by the bushfires forced Premier Brumby to announce a Royal Commission. This resulted in developing 67 recommendations, whereas during the Black Friday fires the Royal Commission issued only seven. The recommendations included modifying building codes and revising the Victorian Government's methods for bushfire preparation and education policies. By following the Prepare Act Survive guidelines, Victorians are more resilient to fight fires than ever before.

"Left behind are families, friends and communities still trying to come to terms with their loss. accompanying this loss of life is the fires' impact on property and the infrastructure that supports communities, as well as the substantial environmental impact, which will take years to fully reveal itself—let alone be ameliorated. it is extremely difficult to quantify the cost of a disaster like this..."
-Bushfire Royal Commission of 2009

In loving memory of the 173 people who passed away during the fires

Figure 24: Black Friday and Black Saturday Display

EVOLUTION OF THE FIRE SERVICES IN VICTORIA

Early Days

Prior to the summer of 1944, the fire services in the state of Victoria were split between three organizations: The Metropolitan Fire Brigade Board (MFBB), the Country Fire Brigade Board (CFBB), and the Bush Fire Brigades. The MFBB was in charge of the operations of the brigades within the city of Melbourne, while the CFBB oversaw the fire brigades in towns 16 km outside of the city. Meanwhile, the Bush Fire Brigades consisted mostly of local landowners who received little to no financial assistance from the government and operated independently from their urban counterparts.

These three organizations lacked coordination. There was no central control over when the burning of firebreaks was safe, as the efficiency of firebreaks depends on weather conditions and the locations of the fires (a firebreak is a gap in vegetation or other combustible material that acts as a barrier to slow or stop the progress of a wildfire). In addition, there was no central body controlling the Bush Fire Brigades across the state, and warning systems were not sufficient.

Bush Fire Brigades

The first bushfire brigades in Australia were formed in the state of Victoria in the early 1900's. On the 5th of January 1901, *The Australasian* reported that residents had organized and equipped bushfire brigades as there had been a concern with "a prolific growth of grass and crops". Over the next several years, more brigades formed across Victoria. After WWI, soldiers that were accustomed to strict military organization saw the advantages of organized brigades and often took charge in creating them.

Throughout the 1920's, bushfire brigades were still informal and operated on a volunteer basis. During this time, the idea to create a state-wide organization that would oversee the bushfire brigades originated. On September 19 1928, the idea became a reality and the Bush Fire Brigade Association was formed. The association was controlled by a central committee that oversaw brigades from seven districts across the state. Over the years, the association was able to advance the brigades on an organizational level, however, it was still not able to convince the government to provide financial support. It wasn't until the disastrous summers of 1939 and 1944 that the bushfire brigades were formally unified under a single operating body.

Ralph brown, a policeman at Mirboo North, mentions how firefighting was very unorganized in the early 1900's
"There was not very much fighting done until the fire menaced the settlers. It was practically impossible to get people to volunteer to go out and fight a fire unless it was going to injure them or some of their friends. They did not take notice until it reached a danger point to settlers and no notice is taken there of fires in Crown Lands... There is no collective system at all in regards to the farmers, until a fire menaces them in a particular area."

Wally Crompton, who was an Assistant Chief Officer in the CFA, recalls his early years in the Wendouree Brigade in Ballarat in 1924:
"We only had a hose and a reel at Wendouree. The brigade could only fight a fire that broke near the station. When a fire broke out you either rode your bike or ran. But the [Ballarat] Brigades also had out-stations in little sheds at various points around the city. Someone would get the call, then go to the outstation and get the reels and hose."

Country Fire Authority

After the devastating bushfire season of 1944, the Victorian State Government was determined to enforce the recommendations given by the Royal Commission of 1939 and establish a more efficient fire management system. To do so, they announced the formation of a new organization: the Country Fire Authority (CFA). The CFA was established as the coordinating body for brigades beyond the jurisdiction of the Metropolitan Fire Brigade. It is still operative after more than seventy years, providing a diverse range of risk reduction, fire suppression and incident management services to minimise the impact of fires and other emergencies on Victorian communities.

This sign marks locations that may provide some protection from direct flame and heat from a fire, but they do not guarantee safety.

Figure 25: Evolution of the Fire Services in Victoria Display

SOCIAL IMPACT

Effects on Individuals

Since the colonization of Australia, hundreds of people have lost their lives due to bushfires in state of Victoria alone. While death is the main concern during natural disasters, life-threatening events such as bushfires often cause physical and psychological trauma that can have both short-term and long-term effects.

Weather disasters such as bushfires, cyclones, floods, and earthquakes cause an increase in cases of mental health issues, alcoholism, domestic violence, chronic disease, and short-term unemployment. There is consistent evidence that up to 40% of people involved in an emergency event are at risk of sustaining severe and protracted psychological injury. As smoke can travel considerable distances, people living hundreds of kilometers away from a bushfire can also be affected – especially if they have a pre-existing heart or lung condition.

Family members comforting each other upon finding out that their parents and brother were among those who died in the Black Saturday fires.

"After that fire, the damage had been done for sure. [Town affected by Black Saturday] looked like a bomb site, just like an atomic bomb had gone off there. There was hardly a leaf left on a tree."
-Firefighter

Community Resilience

Community resilience is an action plan that allows for a community to properly respond, withstand, and recover from adverse situations such as bushfires. Over the years, the CFA has taken the role of educating the Victorian communities on the importance of fire safety. In the aftermath of the Black Saturday fires, the government, emergency forces, and Victorian communities agreed that there was a need for a stronger bushfire resilience plan, thus, the CFA refined its strategy towards creating a more resilient Victoria. Today, the CFA aims to reduce the incidence and impact of fire emergencies on the community of Victoria by encouraging forest cleanups before the start of the fire season, providing educational talks about how to prepare for bushfires, and informing the public on how to properly evacuate in a state of emergency.

Effects on Communities

As bushfires sweep through populated areas they destroy whole towns, leaving families homeless and separating people from their loved ones. When a natural disaster first destroys a community, the members of that community may find it hard to rely on each other for emotional support, as there is no longer a common space for the members of the community to gather and assist one another. As time passes and the initial shock fades away, communities find themselves closer than ever as families work together to rebuild their towns. bushfires disrupt the lives of workers, employers, and families, in addition to creating instability in local labor markets. As a result of the Black Saturday bushfires in 2009, the estimated social costs were larger than the financial costs. Direct health care system costs, productivity losses, and justice system costs amounted to be at least $3.9 billion, while direct financial impacts amounted to $3.1 billion.

The town of Marysville was burnt to the ground during the Black Saturday fires in 2009. More than 30 people died and over 400 buildings were destroyed, leaving only 2-3 buildings standing. In the picture below are two residents of the town, looking through the remains of what used to be their home.

Citizens of Kinglake trying on donated clothes after losing everything during the 2009 fires

Prime Minister Rudd hugs CFA members in Wandong, Victoria

CFA volunteers providing an educational talk to members of Victorian communities

10 years later, Marysville is fully rebuilt, but the effects the fire had on the community will last for generations

Figure 26: Social Impact Display

Figure 27: Picture Display

4.2 Interactive Bushfire Timeline

Information on how to use and navigate the timeline application can be found in the Anniversary Bushfire Exhibit Setup Manual.
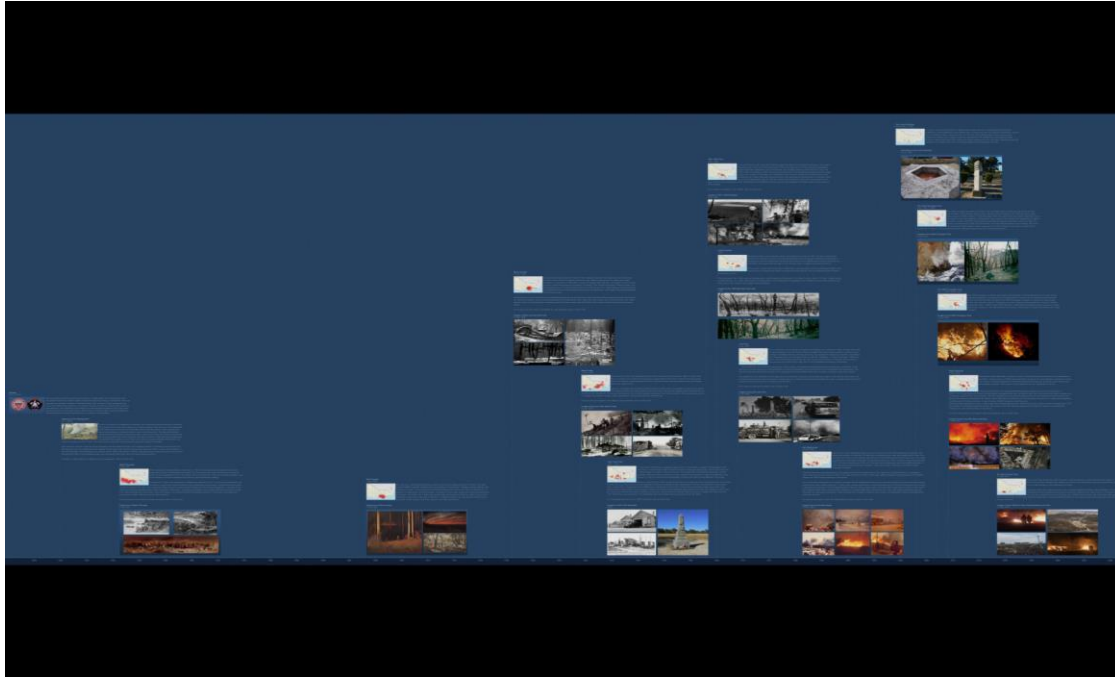
Figure 28: Bushfire Timeline Overview
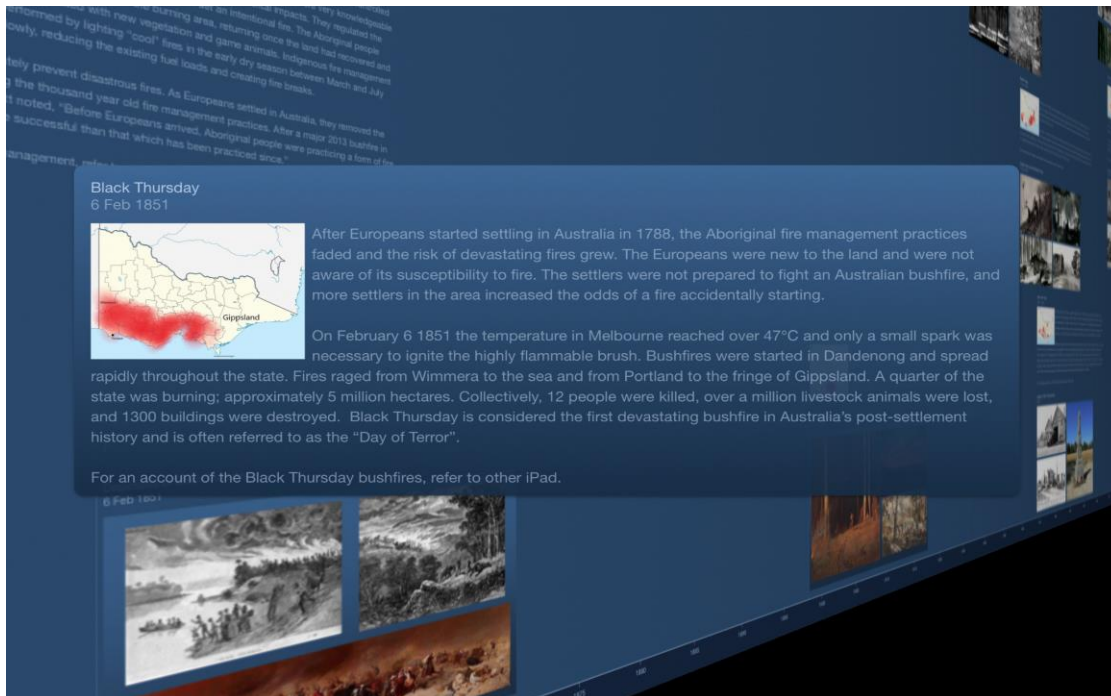
Figure 29: Event on Bushfire Timeline

Figure 30: Zoomed in Photo on Bushfire Timeline

4.3 Interactive Personal Accounts Timeline

Information on how to use and navigate the timeline application can be found in the Anniversary Bushfire Exhibit Setup Manual.
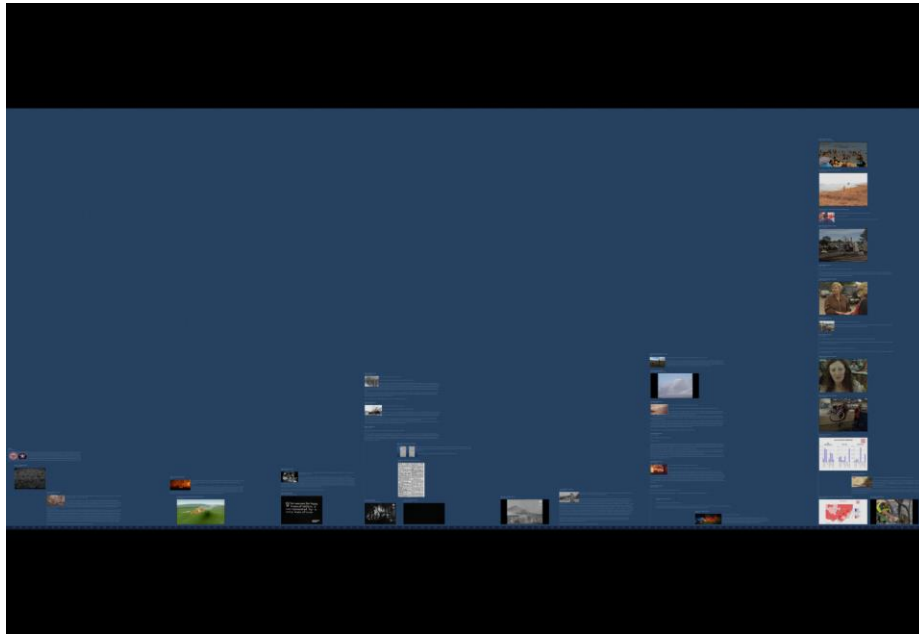
Figure 31: Overview of Personal Accounts Timeline
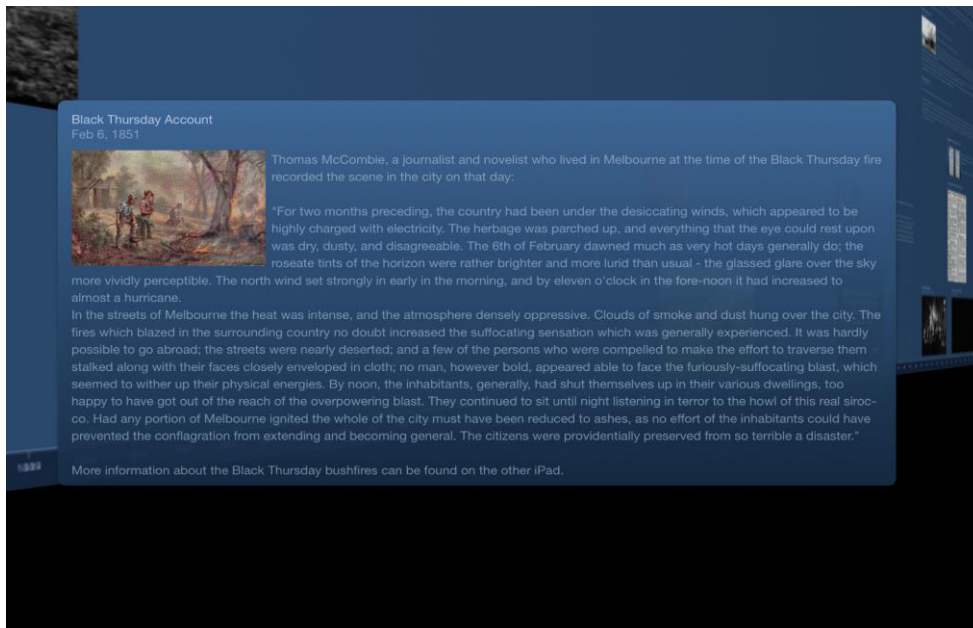
Figure 32: Event on Personal Accounts Timeline
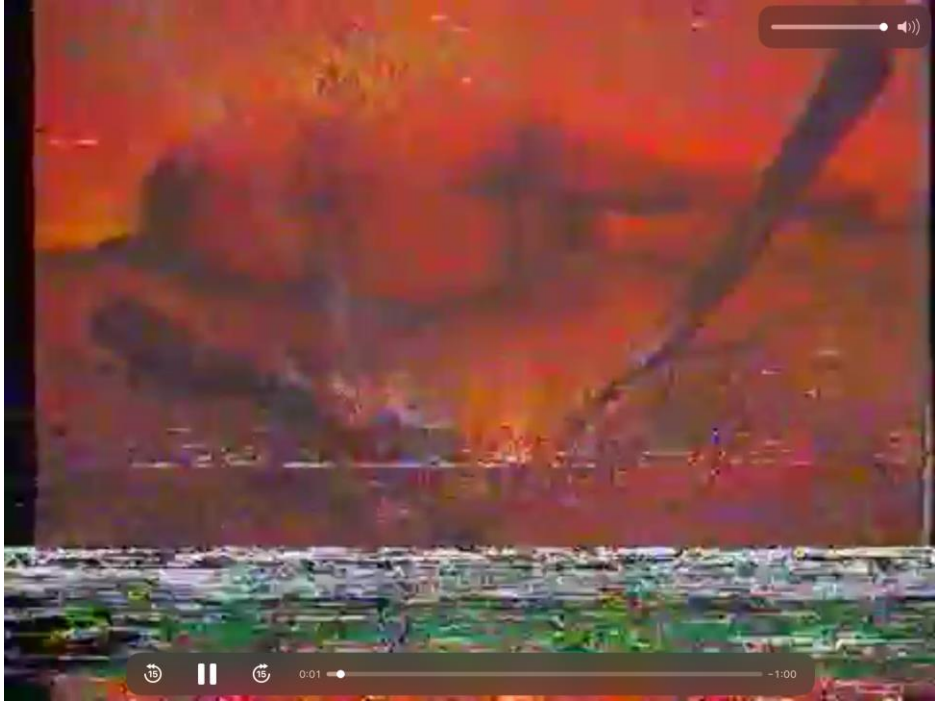
Figure 33: Zoomed in Video on Personal Accounts Timeline

4.4 Anniversary Bushfire Exhibit

Figure 34: Anniversary Bushfire Exhibit

Figure 35: Anniversary Bushfire Exhibit Displays
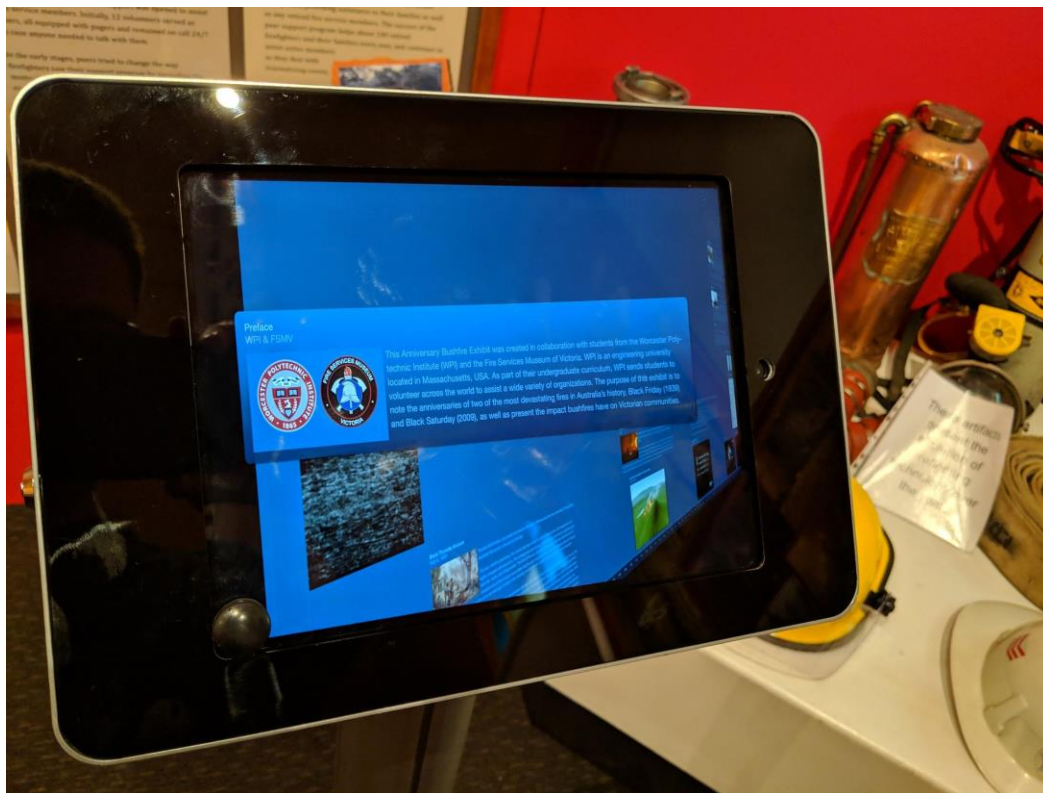
Figure 36: Timeline on iPad

The artifacts we obtained:

Figure 37: Artifacts

Folded display stands:

Figure 38: Folded Display Stand

Set-up display stands:

Figure 39: Setup Display Stand

4.5 Newspaper Binders

The two newspaper binders consist of one made up of the fires included in the timeline, and the other binder made up of the Black Saturday fires.
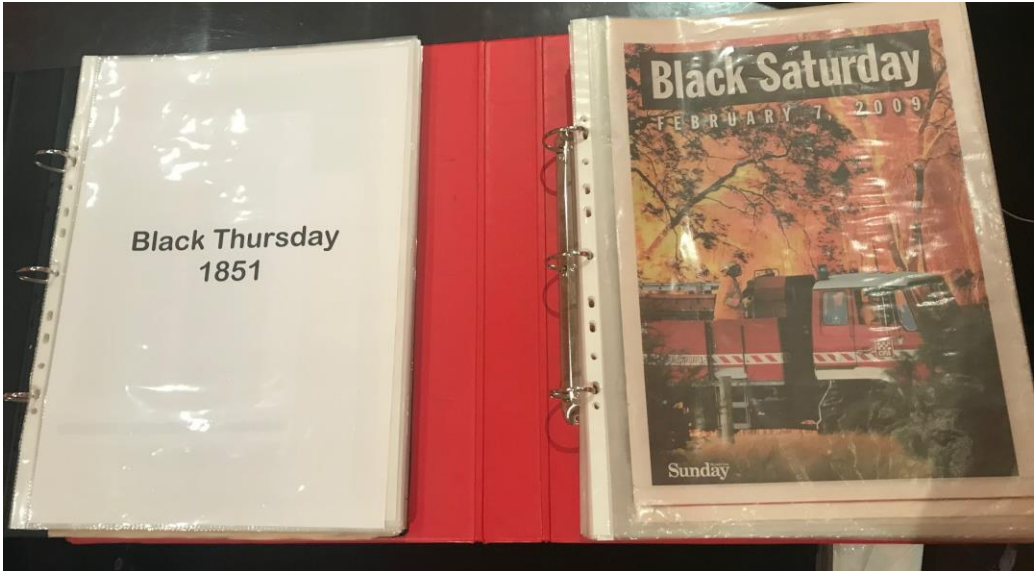
Figure 40: Newspaper Binders
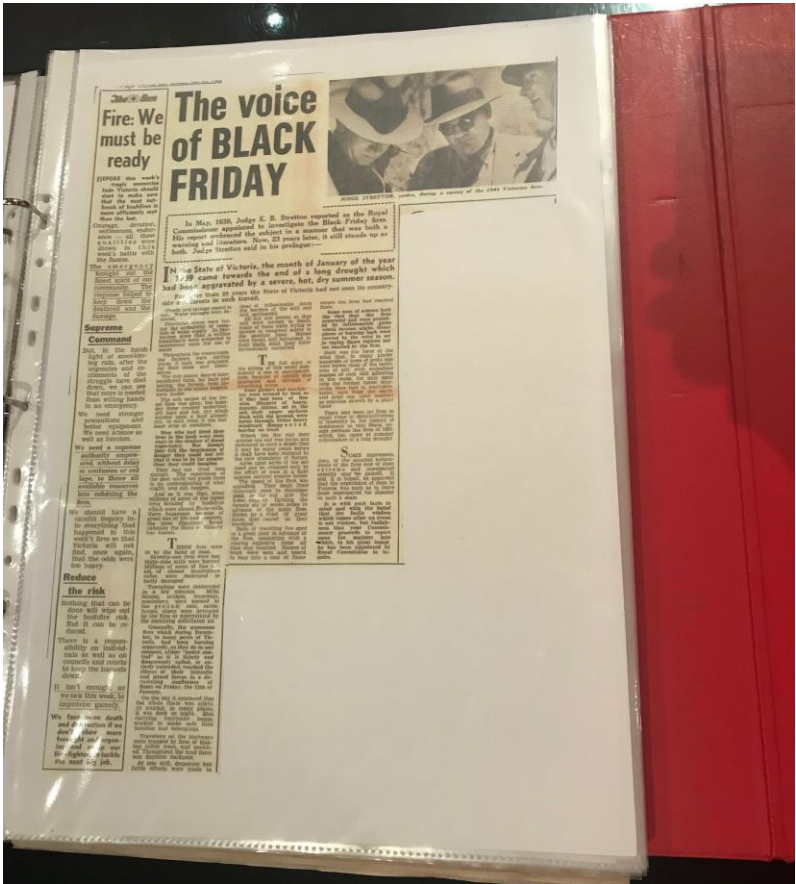
Figure 41: Article in Timeline Fires Binder

Figure 42: Article in Black Saturday Binder

4.6 Exhibit Setup Manual

The setup manual details the assembly of the display stands and how to set up the iPad interactive timelines. A copy of this manual is printed and kept at the Fire Services Museum of Victoria for their own personal records. By request, the FSMV can produce and distribute copies of the manual, ensuring that whoever is in possession of the exhibit can assemble it. The details of this manual can be found in Appendix B.

What We Envision for the Exhibit

According to our observations and interviews we conducted with the museum's personnel, we learned that most of the visitors at the Fire Services Museum of Victoria go through guided tours led by one of the museum's personnel. As the groups walk through the museum, the volunteers tell stories and explain what different artifacts are. The exhibit we created is unique to the FSMV, as it contains all the information within it. Thus, there is no need to be guided through it.

The Anniversary Bushfire Exhibit consists of a great deal of information relating to the history of the bushfires in the state of Victoria, allowing visitors to spend anywhere between several minutes to an hour reading through the exhibit. Although we do not expect the average person to spend a full hour looking through our exhibit, we would like to allow visitors the option to do so.

We envision for the Gallery Room, the room in which our exhibit will be set in, to be the last room visited during the guided tour. This will allow visitors to spend as much time as they would like to go through our exhibit. As the museum's personnel brings visitors in the room, we would like them to point out the Anniversary Bushfire Exhibit, provide them with general information about the exhibit, and then let them read through it at their own pace. The provided information should include some of the following points:

- The anniversary bushfire display is dedicated to the Black Friday and Black Saturday fires that happened in the state of Victoria, as 2019 marks their anniversary.
- The historical timeline tells the stories of 15 major bushfires that occurred in the state of Victoria.
- The other timeline contains personal stories of people who were affected by bushfires, as well as several videos.
- The displays discuss: how bushfires start and spread, the struggles firefighters go through, the social impact of wildfire, and the evolution of fire services over the years.

Appendix

Appendix A: Interview Questions

The following subsections consist of interview questions for the designated participants:

1. Firefighters
- What motivated you to be a firefighter?
- When did you start your career as a firefighter?
- Can you give us any specific examples of a relevant technology?
- What are some of the most dangerous aspects of your job that could be made safer?
- Wildfires are widespread in Australia, making firefighting much more significant than in other countries. How is this translated in your everyday work in comparison to other locations around the world?
  - What personal challenges come with that responsibility?
- How were you involved in [   ] fires? If so, could you share your experience or any stories from that event?
  - (If yes to the previous question) What would you like to see in an exhibit commemorating the firefighter's bravery and telling the stories of the fires?
- What kind of difficulties arose during the duration of the fire?
  - What were you thinking/what was your mindset throughout the [   ] fires?
  - What aspects of the fighting were especially good, and what could have been improved?
  - What kind of support was given by foreign countries?
- How has technology impacted the way we fight fires and how does that affect firefighters and the emergency forces?
- What, if anything, could be improved in firefighting safety and efficiency today?

2. Museum Personnel
- What value do you think the museum brings to Melbourne and the state of Victoria in general?

- Why did you choose to volunteer at the FSMV?
- What groups of people most commonly visit the museum?
- What exhibits do you think are the most popular? Why do you think they are popular? Are there any common themes popular exhibits have?
- What is your favorite aspect and/or exhibit of the Museum and why?
- In developing the exhibit:
    - What information or lesson would you want visitors to leave with?
    - What do you want to see in the exhibit guide?
    - What are your thoughts on the peer support program? What kind of effects does it have on firefighters? How aware is the public of this program?
- Out of all the fires you have experienced, which one stands out and why?

Anniversary Bushfire Exhibit

Setup Manual

Produced By: Arkady Gobernik, Dan Duff, Jake Spada, and Nick Janco

Table of Contents (As Shown in the Manual Copy)

Display Stand Setup

Assembling your display stand

You should receive your stand in six pre-assembled parts. There are three bases and three folding supports for 6 display boards. Each base is labeled with its corresponding folding support, and it is essential each base is attached to its correct support. They will be labeled numbers 1 through 3. The base has a label underneath and the folding support will be labeled along the vertical beam.

Step 1

Depicted above are the base and folding support that each stand consists of. Start the assembly by detaching the two bolts with their corresponding washer and wingnut that will be attached to the brackets on the base.
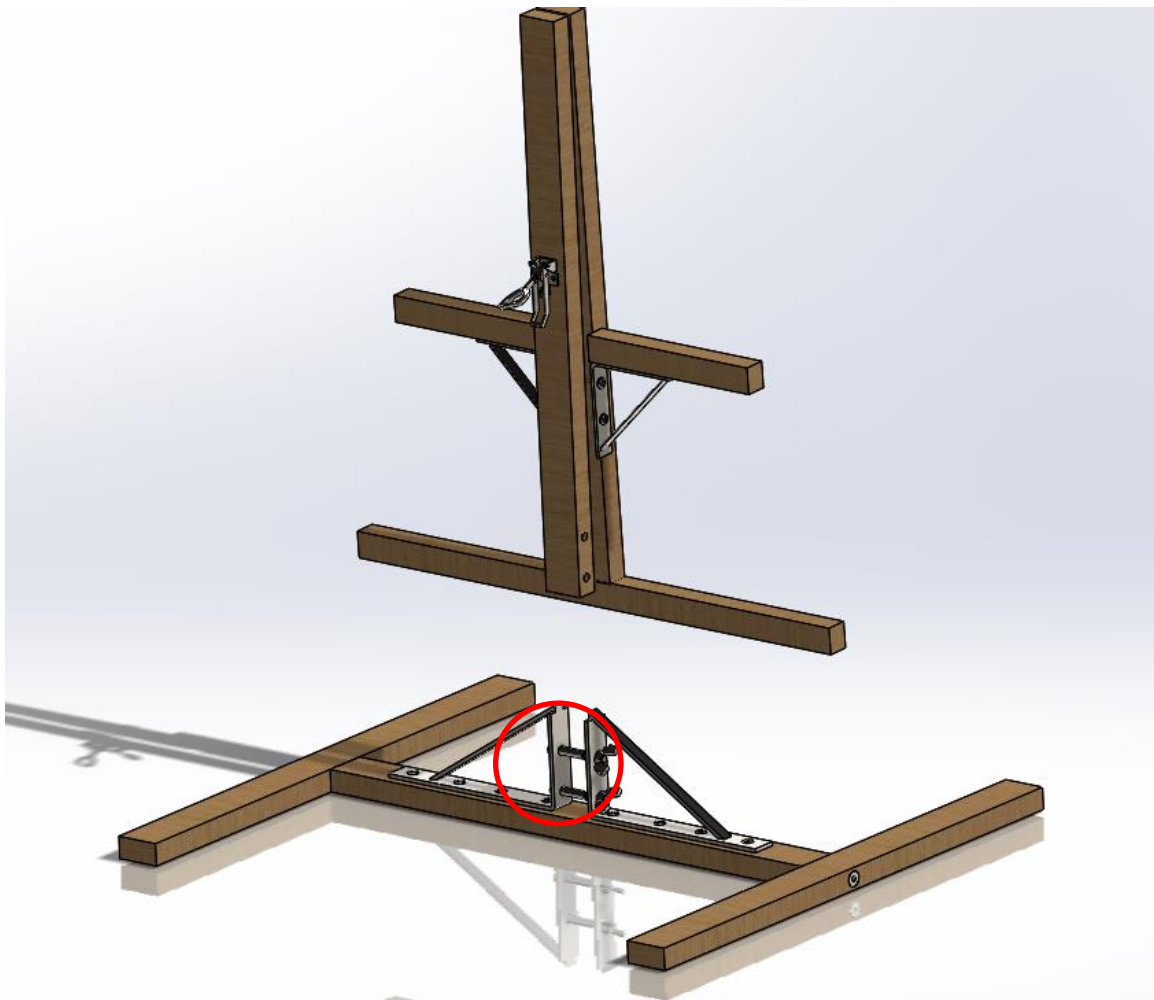
Step 2

Next, place the folding support inside the brackets on the base, aligning the bolt holes with the bracket holes as best as possible. Insert the bottom bolt first, securing it into place with a washer and wingnut. Finish securing the support to the base by inserting the second bolt and fastening it.

Note: If any difficulties arise while inserting or removing the bolt, use a hammer and gently tap or pull the bolt into place.

Step 3

Ensure stand now looks like the model below, remaining in a folded position.
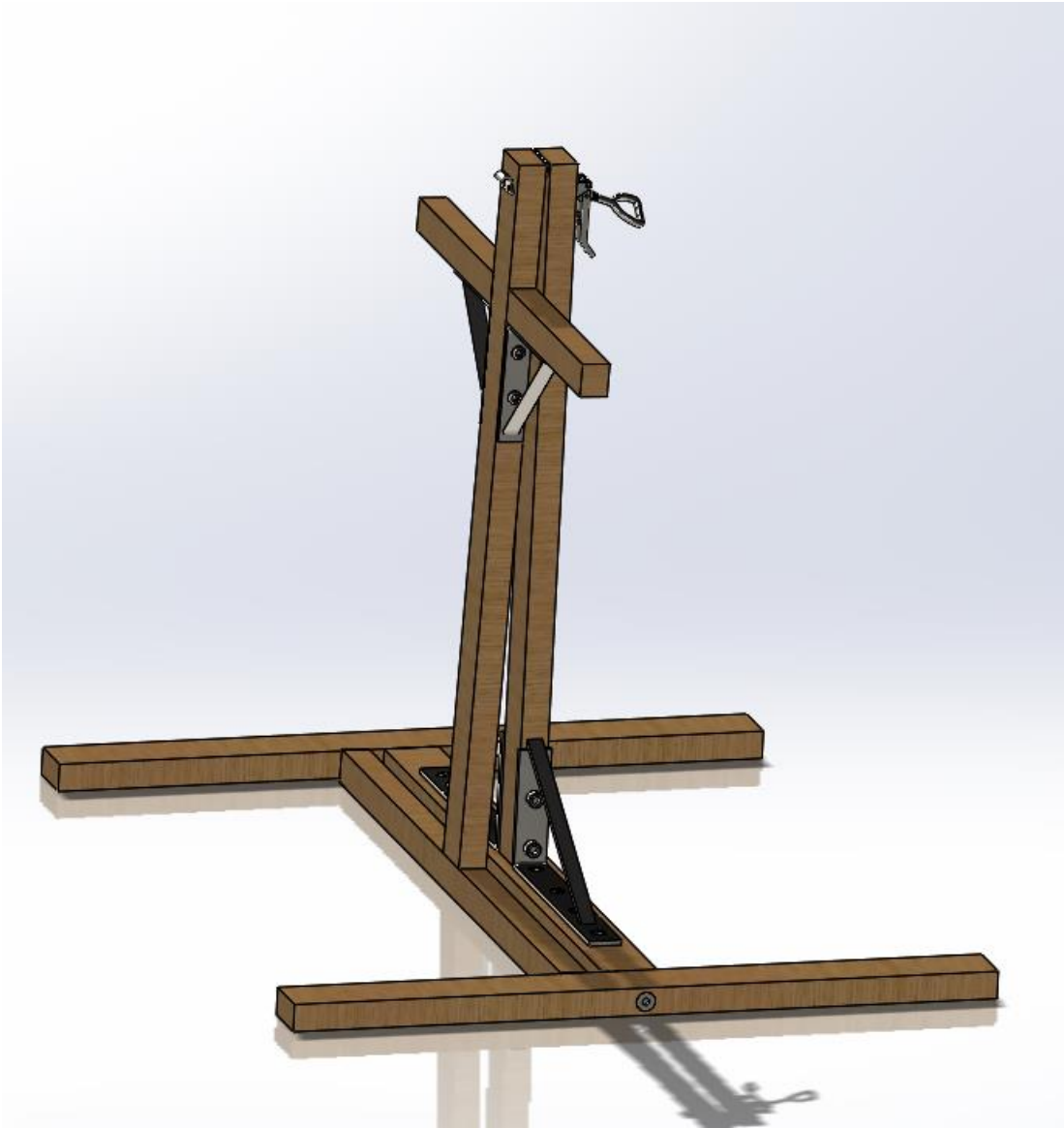
Step 4

Lift the support and begin the straighten it at the hinge.
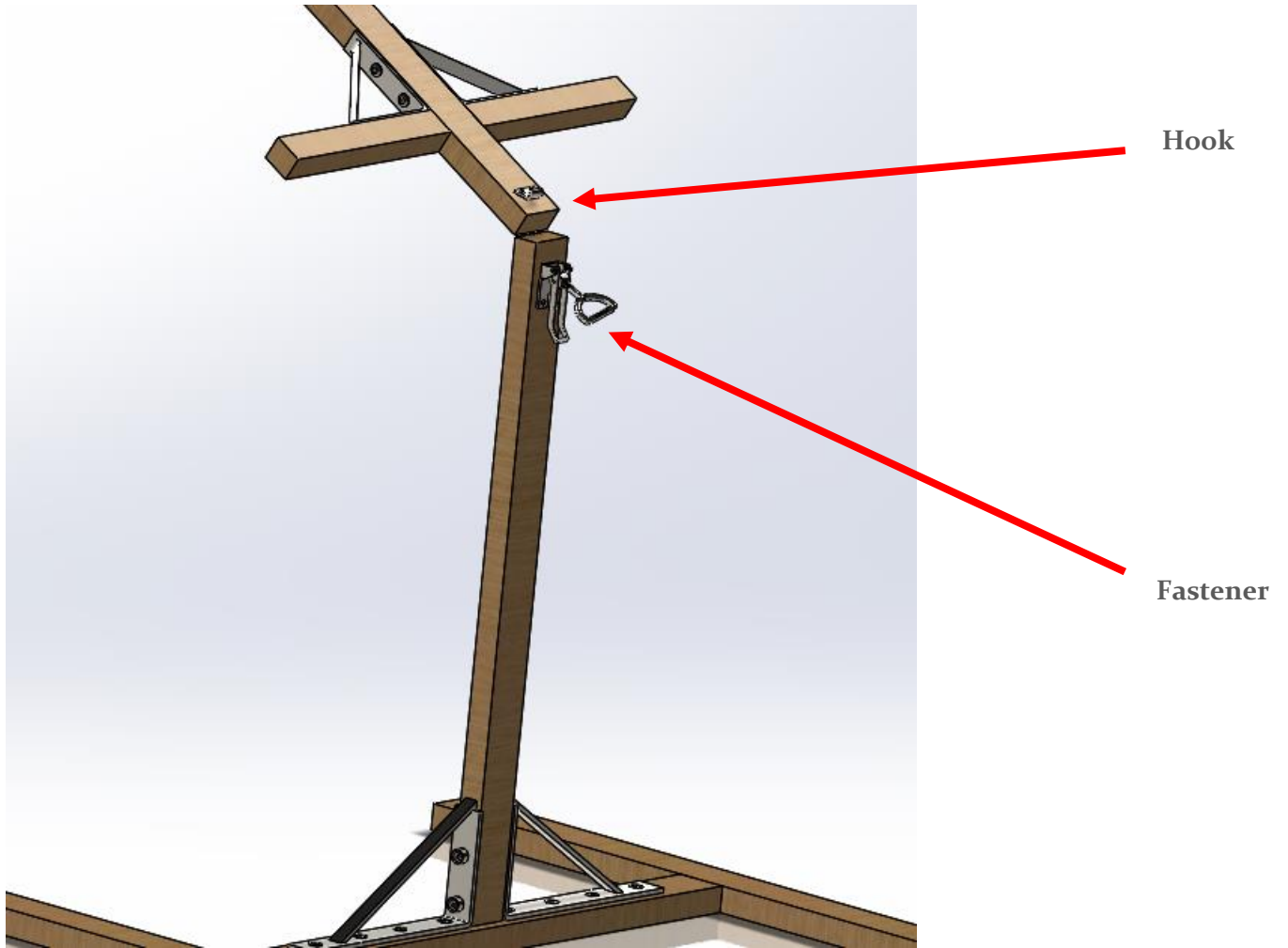
Hook

Fastener

Step 5

Secure the attached clamp so that the hook and fastener are tightly secured. The fastener (the triangle shaped rod that secures to the hook) can be tightened and loosened by twisting it for the desired tightness. Make sure the display stand is sturdy and the clamp is tight before attaching display boards to each side.
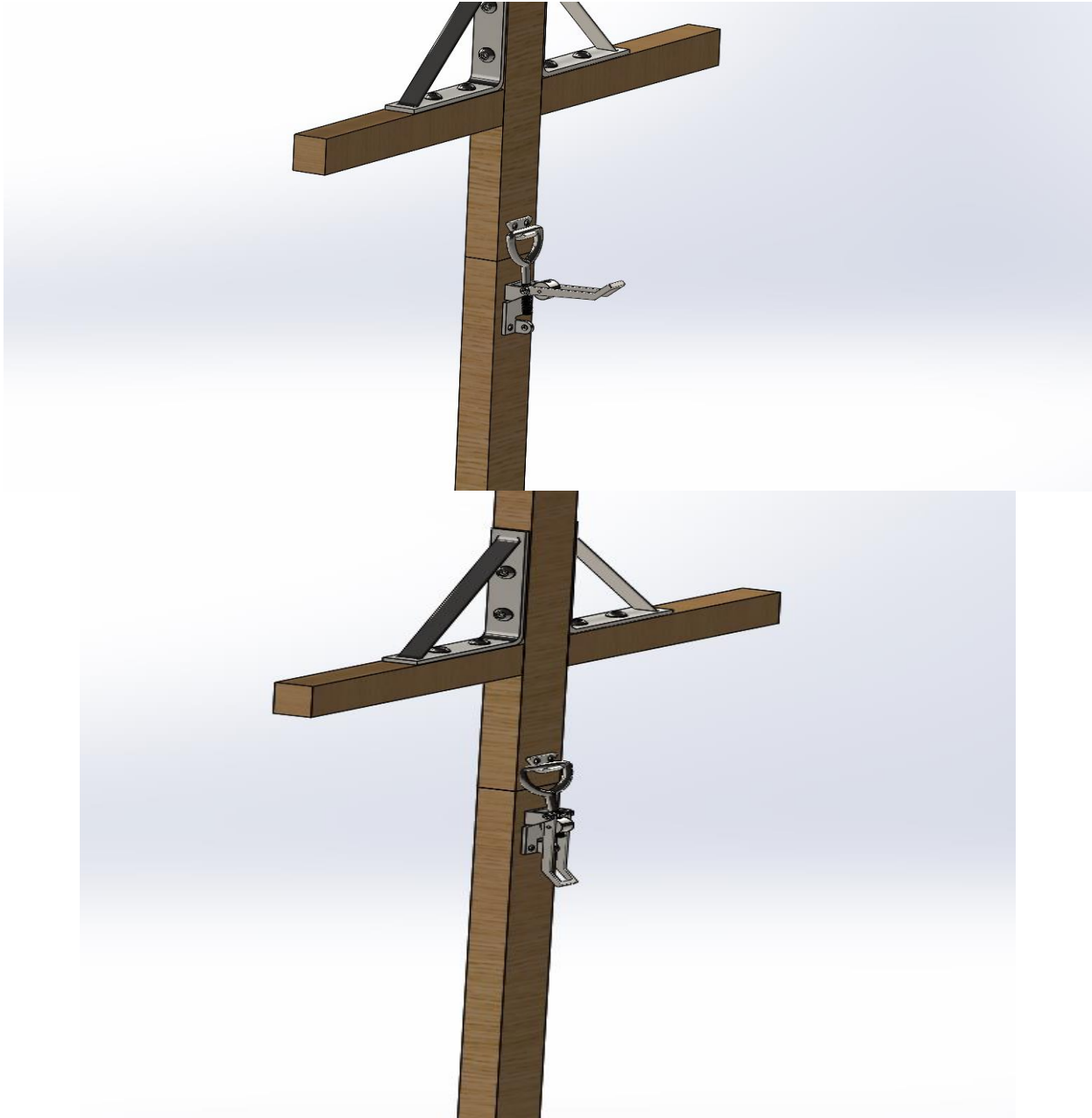
Your finished stand should look like the model below

Timeline 3D: Education Edition 4+

Timeline 3D is the simplest way to create beautiful multimedia timel

This education edition includes all of the functionality of Timeline 3I
and enterprises to manage....
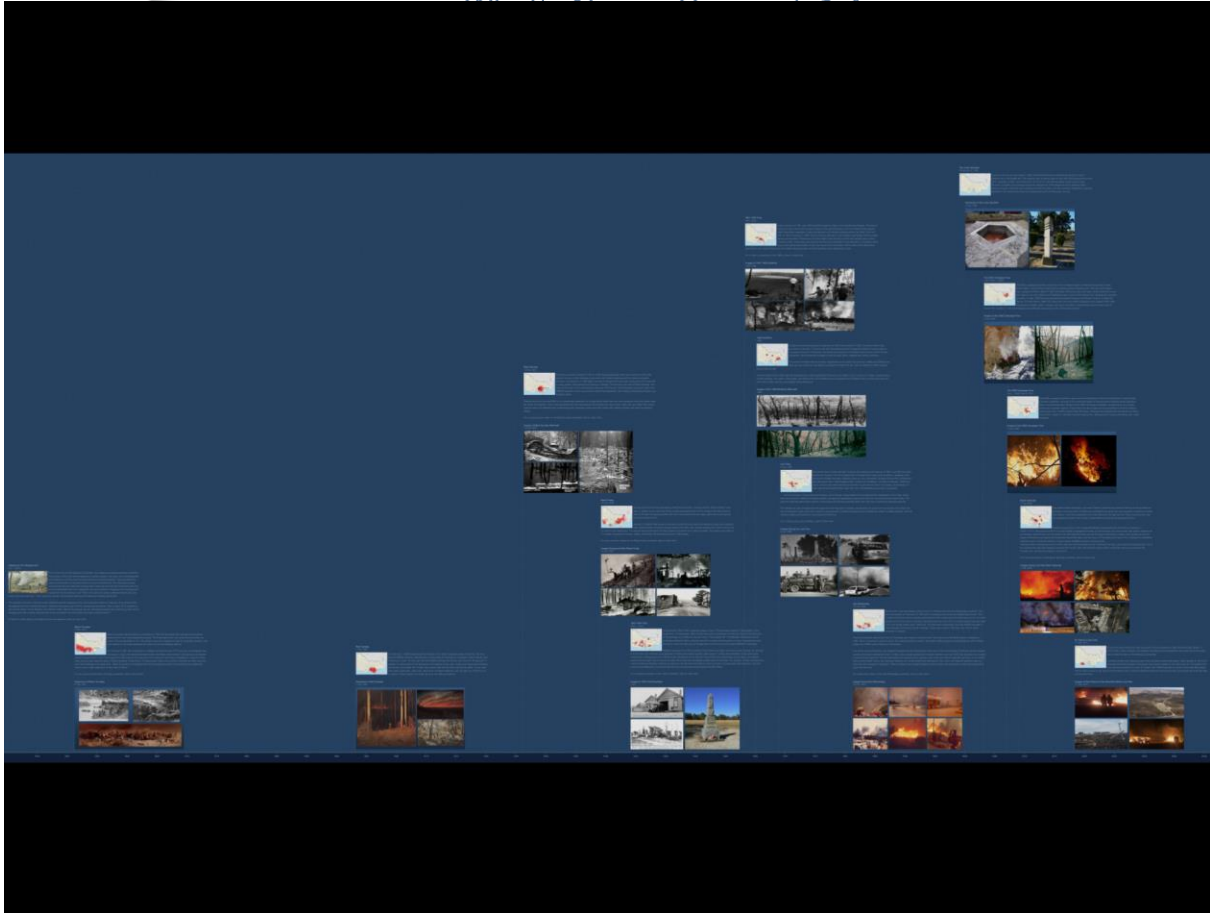
Timeline 3D: Education Edition Setup

Easy Timeline Setup

In order to set up and start using the timelines quickly, refer to the following steps:

1. Turn on the iPad. This can be done by holding the "lock" button as shown below:

2. Once the iPad, has started up, press the "home" button to unlock it as shown below:

3. Once logged into the iPad, select the *Timeline 3D* app as shown below:
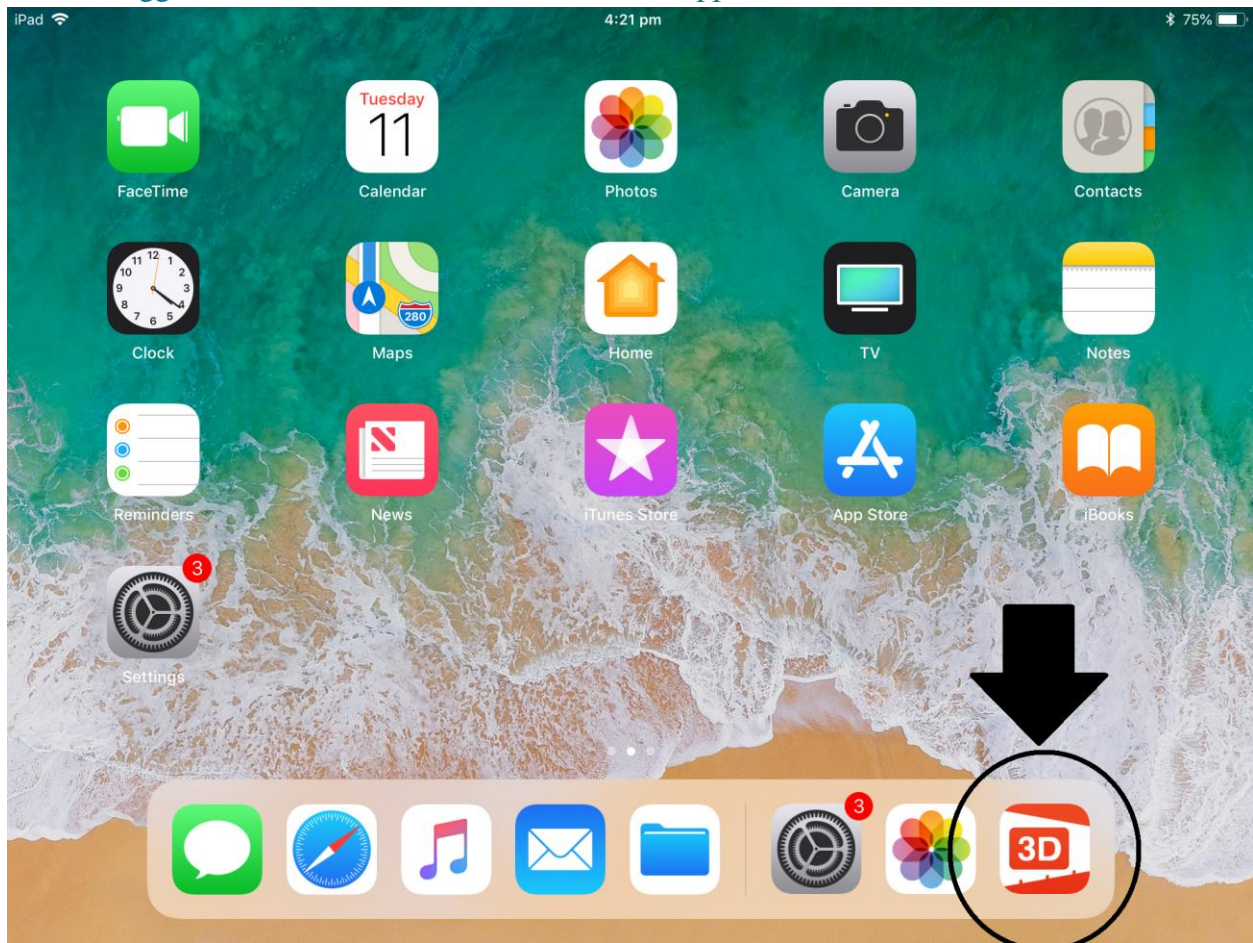
Now that the iPads have been set up, the timeline application will have to be launched:
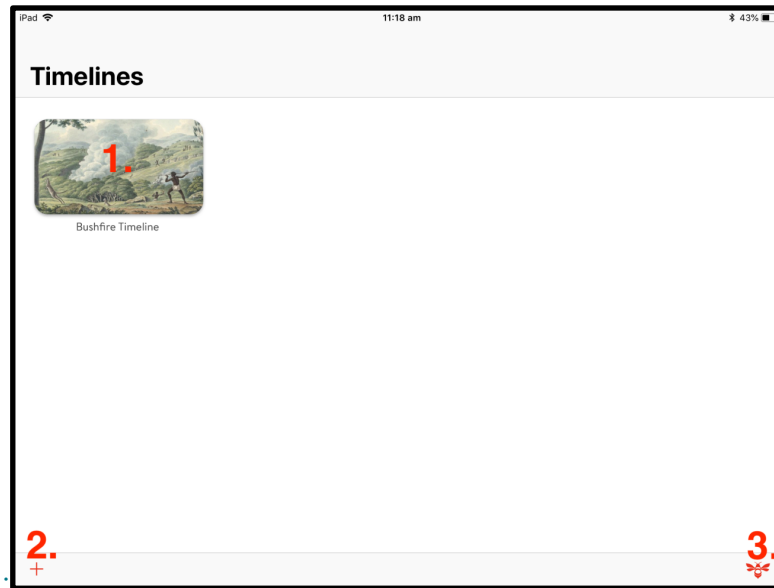
4. Tap the timeline you wish to open (in this example, you would tap *Bushfire Timeline (1)*).
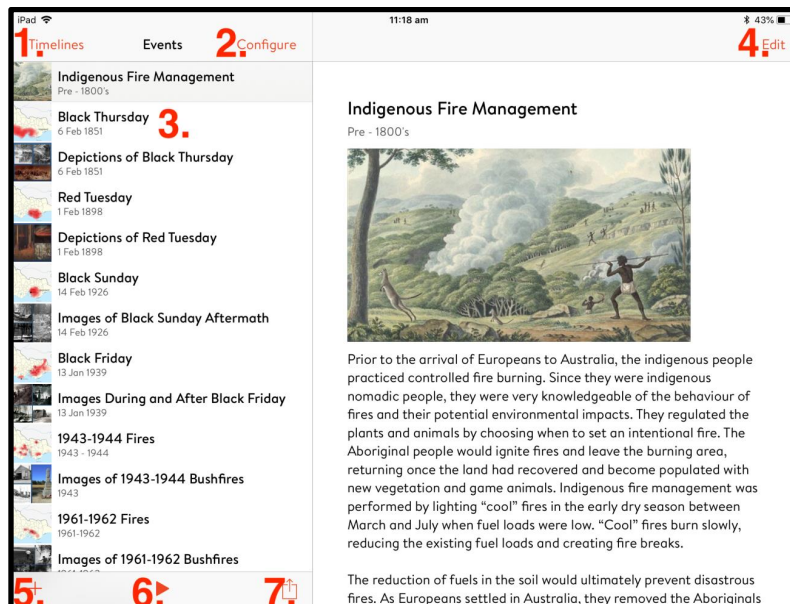
5. Then, select the *Play* button (6) to open the timeline.
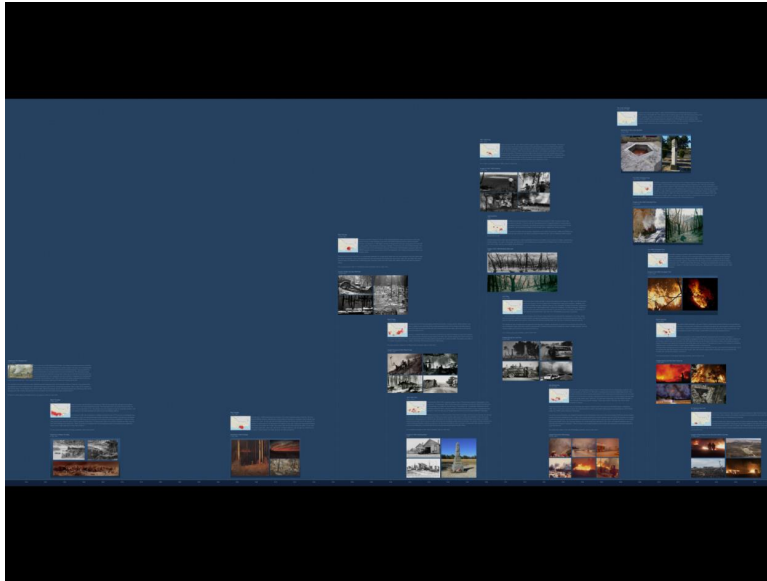
6. The timeline should now be good to go! Tap an event to start, and swipe left/right to navigate.

7. **After locking up the iPad back into its metal strand, be sure to place a rubber stopper in the lower left-hand corner,** so as to prevent visitors from exiting the timeline.

Further Timeline Details: Starting From Main Screen
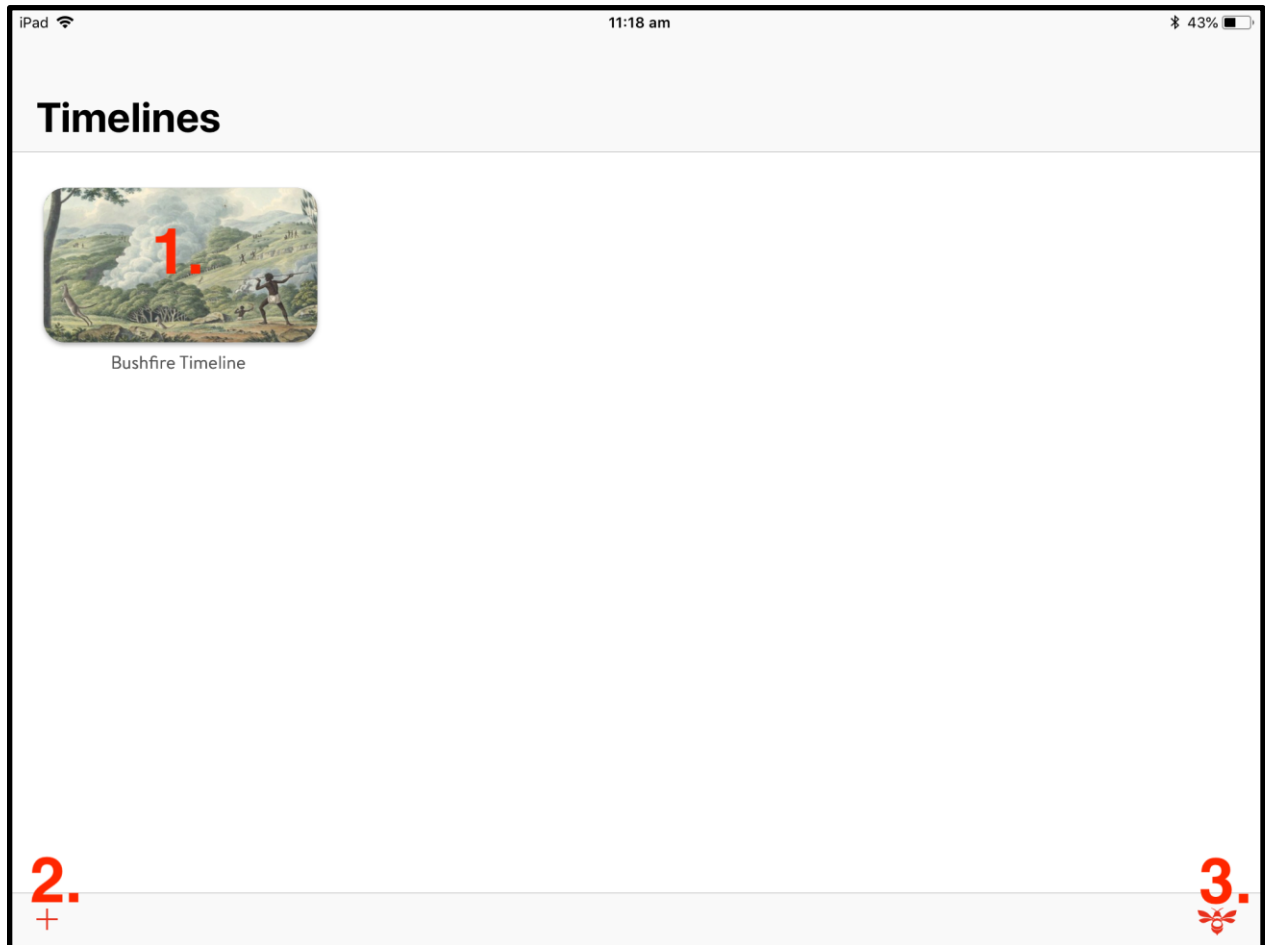
The main screen of the app consists of three options to tap onto:

1. **Access to the timeline:** For setting-up or editing an existing timeline
2. **Creating a new timeline:** For creating a new timeline
3. **BEEDOCS Contact:** Additional options provided by the app's creator

1. Access to the Timeline
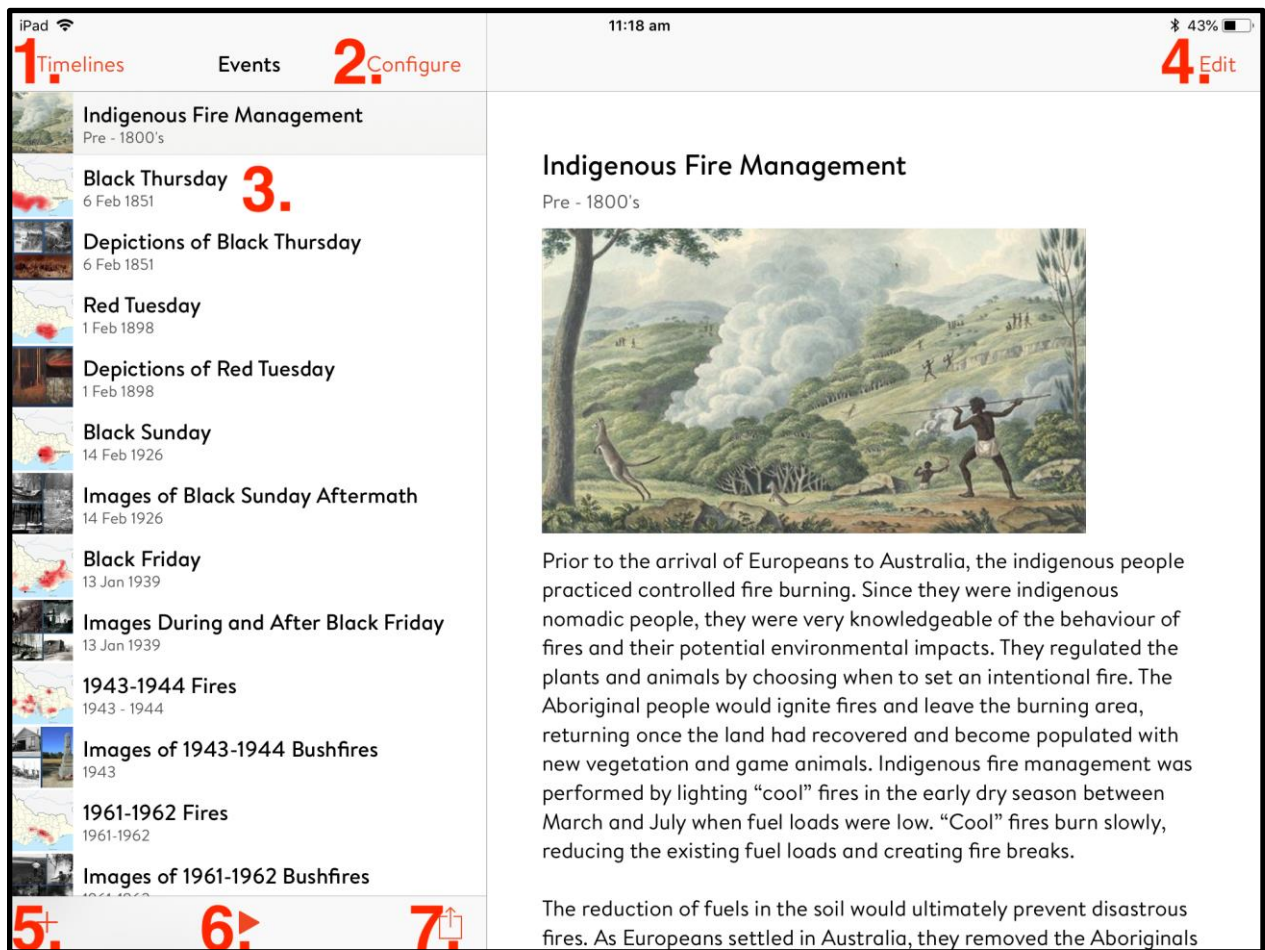
The timeline screen consists of seven options to tap on:

1. **The Timelines button brings you back to the main screen**
2. **The *Configure* button provides additional options when designing the timeline (Refer to 1.1 for additional information)**
3. **Tap on each event in the timeline to see what information is included.**
4. **The *Edit* button allows you to edit events (Refer to 1.2 for additional information)**
5. **The *Add (+)* button allows you to create a new event (Refer to 1.3 for additional information)**
6. **The *Play* button creates the timeline (refer to 1.4 on how to interact with the timeline)**
7. **The *Export* button allows the timeline to be exported as a PowerPoint, video, PDF, etc.**

1.1 Configure Button
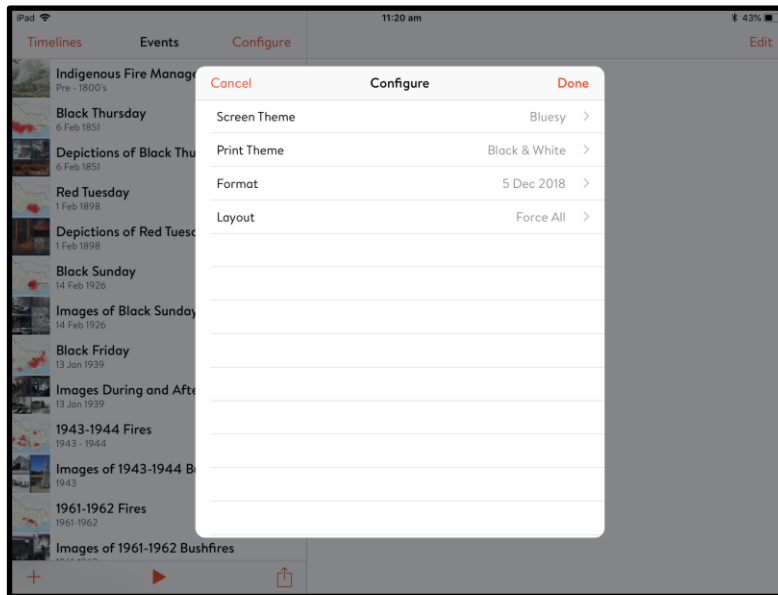
The *Configure* button consists of four options: Screen Theme, Print Theme, Format, and Layout.
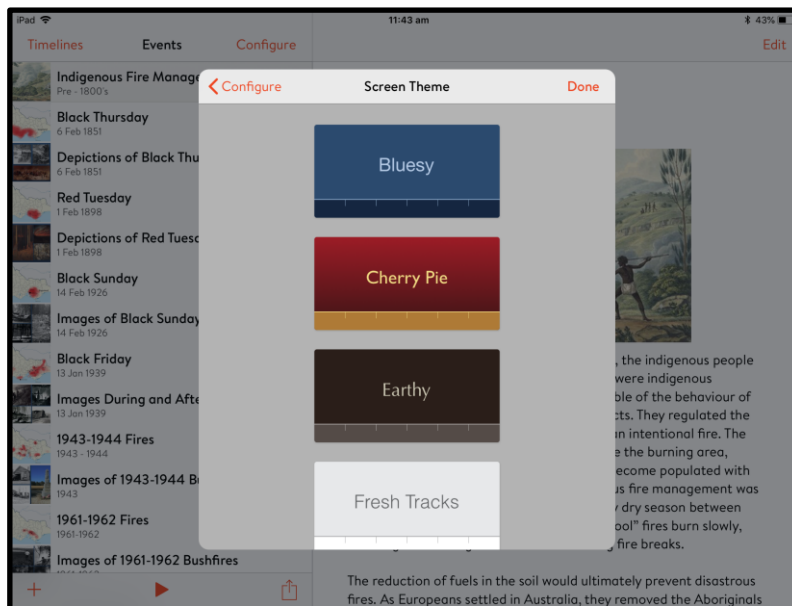
Screen Theme: Choose which theme to use in the timeline. This will determine the background and text colors of the timeline.
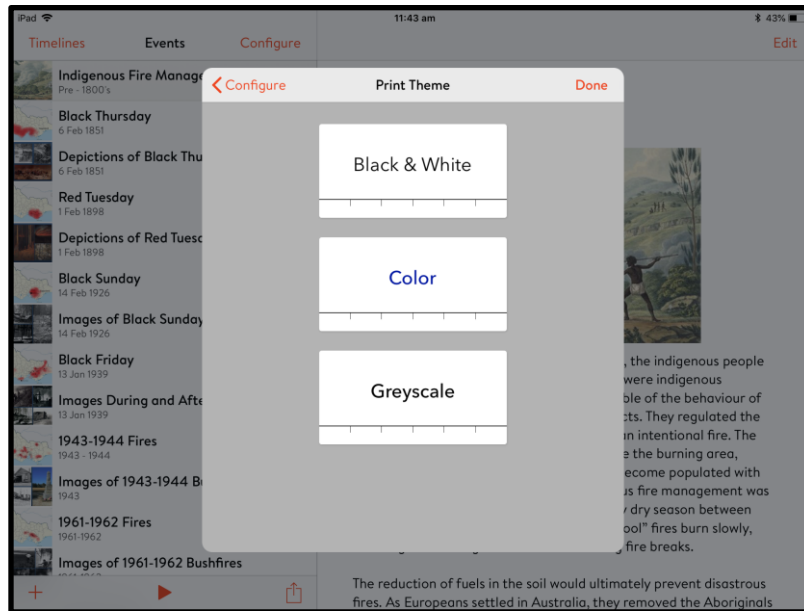
Print Theme: Choose which theme to use in the timeline when printing onto paper.
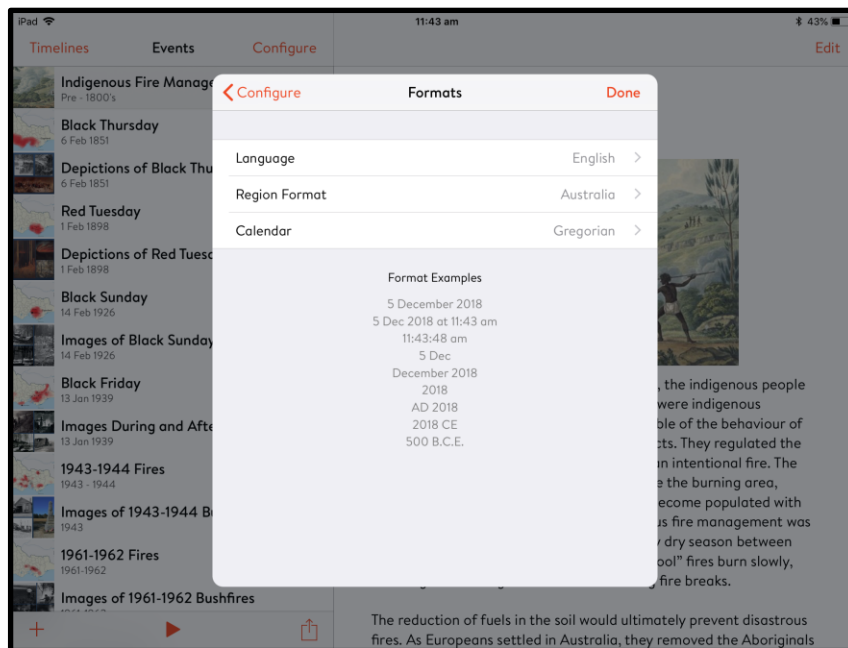
Format: Choose what language, region, and calendar to use. This will determine the format of the date and language as shown on the timeline.

Timelines   Events   Configure   Edit

Indigenous Fire Manage
Pre - 1800's

Black Thursday
6 Feb 1851

Depictions of Black Thu
6 Feb 1851

Red Tuesday
1 Feb 1898

Depictions of Red Tues
1 Feb 1898

Black Sunday
14 Feb 1926

Images of Black Sunday
14 Feb 1926

Black Friday
13 Jan 1939

Images During and Afte
13 Jan 1939

1943-1944 Fires
1943 - 1944

Images of 1943-1944 B
1943

1961-1962 Fires
1961-1962

Images of 1961-1962 Bushfires

‹ Configure   **Layout**   Done

Allow Information Hiding

Timeline events are automatically arranged on a chart. In order to maintain a readable text size, Timeline 3D may truncate some information as needed. For example, the event notes may be shortened, or the images may be hidden.

If you require that all available information must be shown in your charts, even at the expense of text readability, you may turn this feature off.

, the indigenous people
were indigenous
ble of the behaviour of
cts. They regulated the
n intentional fire. The
e the burning area,
ecome populated with
us fire management was
y dry season between
ool" fires burn slowly,
fire breaks.

The reduction of fuels in the soil would ultimately prevent disastrous fires. As Europeans settled in Australia, they removed the Aboriginals

Layout: Option to allow information hiding. This option essentially limits the amount of text shown on each timeline event. Unless specifically desired, this option should always be set to *Off.*

79
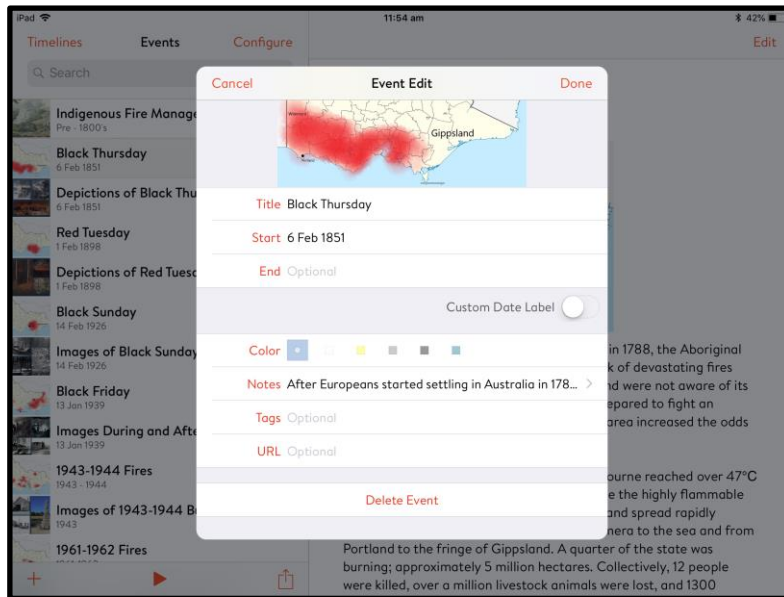
1.2 Edit Button

The *Edit* Button is used for modifying an existing event on the timeline. After selecting an event, tapping the *Edit* button will show the edit dialogue for the selected event.

- **The title can be changed by tapping on the Title box.** This is displayed above the event in the timeline.

- **The start date can be changed by tapping on the start and end boxes.** This determines where on the timeline the event will be placed.
- **The date can also be named anything with the custom date label.**
- **The color of the text can be changed in the color box by tapping on a color.**
- **The notes box allows to you add or change the text of the event.** This is the text that is displayed for the event on the timeline.
- **The tags box allows you tag the event.** Only for organizational purposes.
- **The URL box allows you to add a website link to the event.** This allows an event to show a website page. This option should only be implemented if an internet connection is guaranteed.
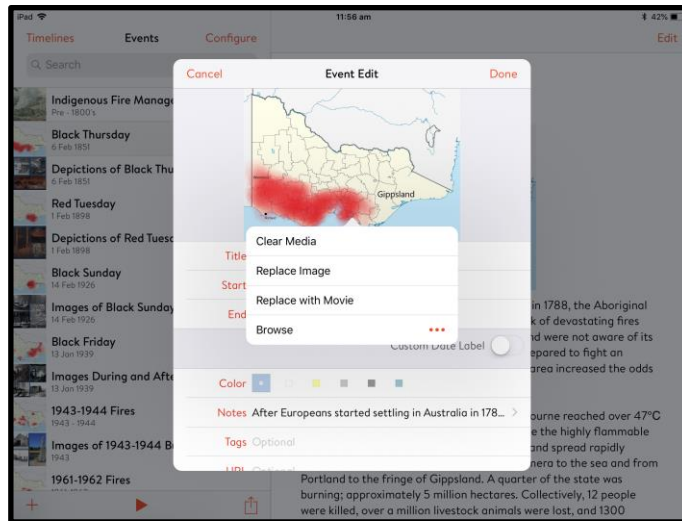
- **By tapping on the media, you can clear media, replace image, replace with movie, or browse for images/movies elsewhere.**

1.3 New Event Button
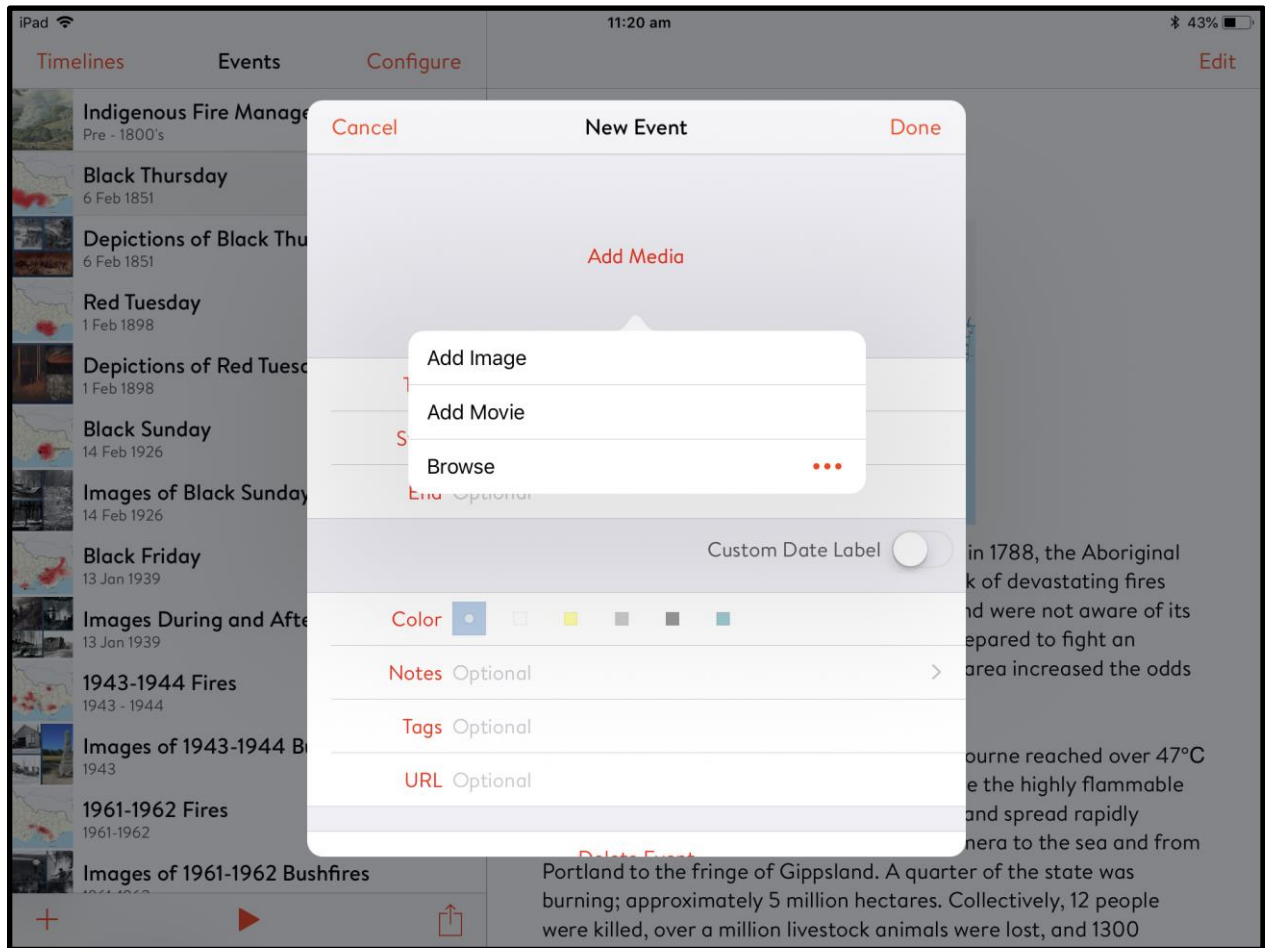
The New Event button has the same options as the edit button. Refer to 1.4 for further information.

1.4 Interacting with Timeline
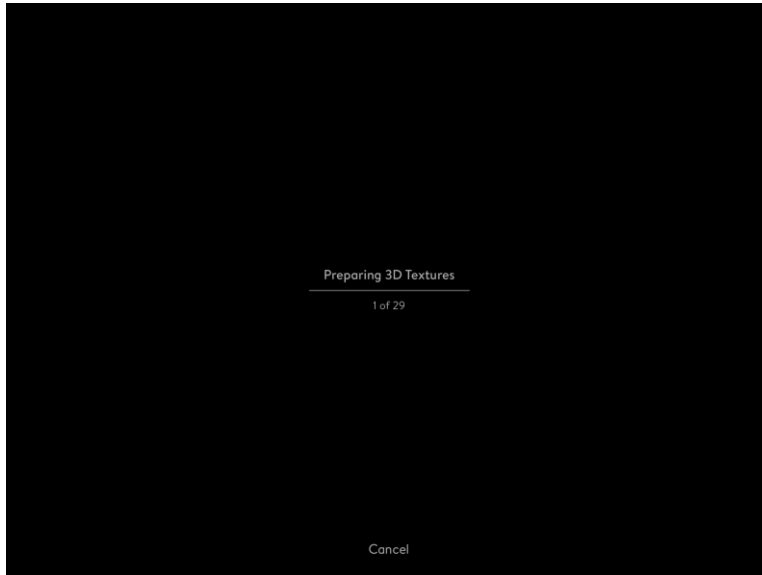
Once the timeline play button is tapped, the 3D timeline will start to load.
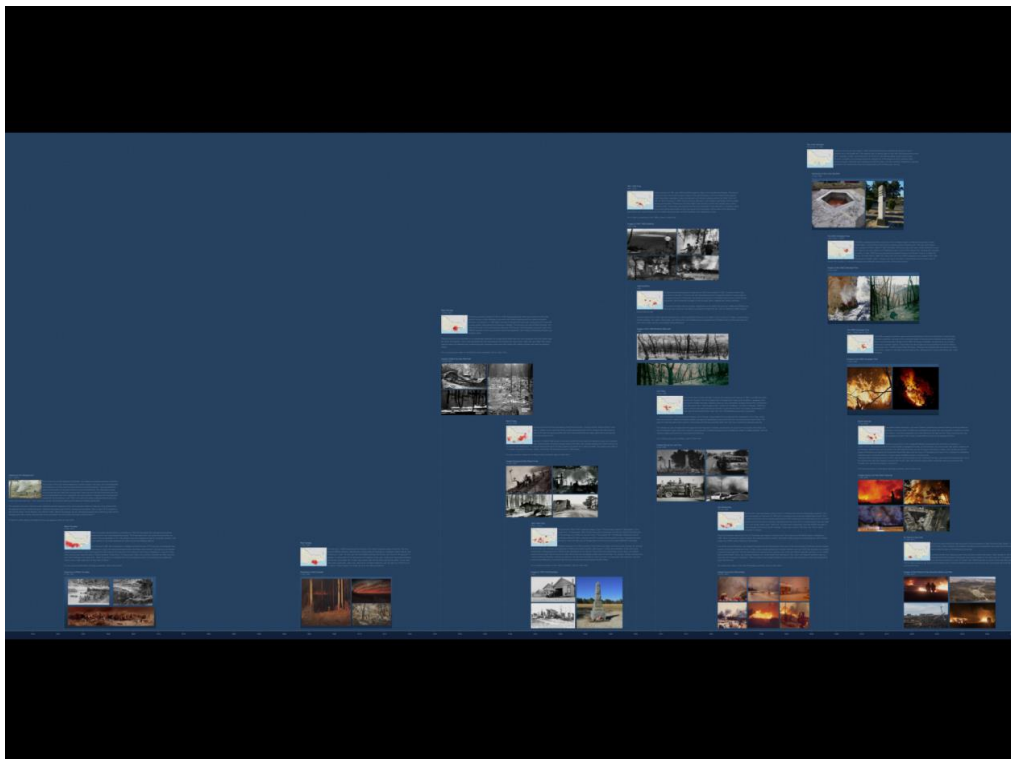
The timeline screen will first show the timeline as a whole.
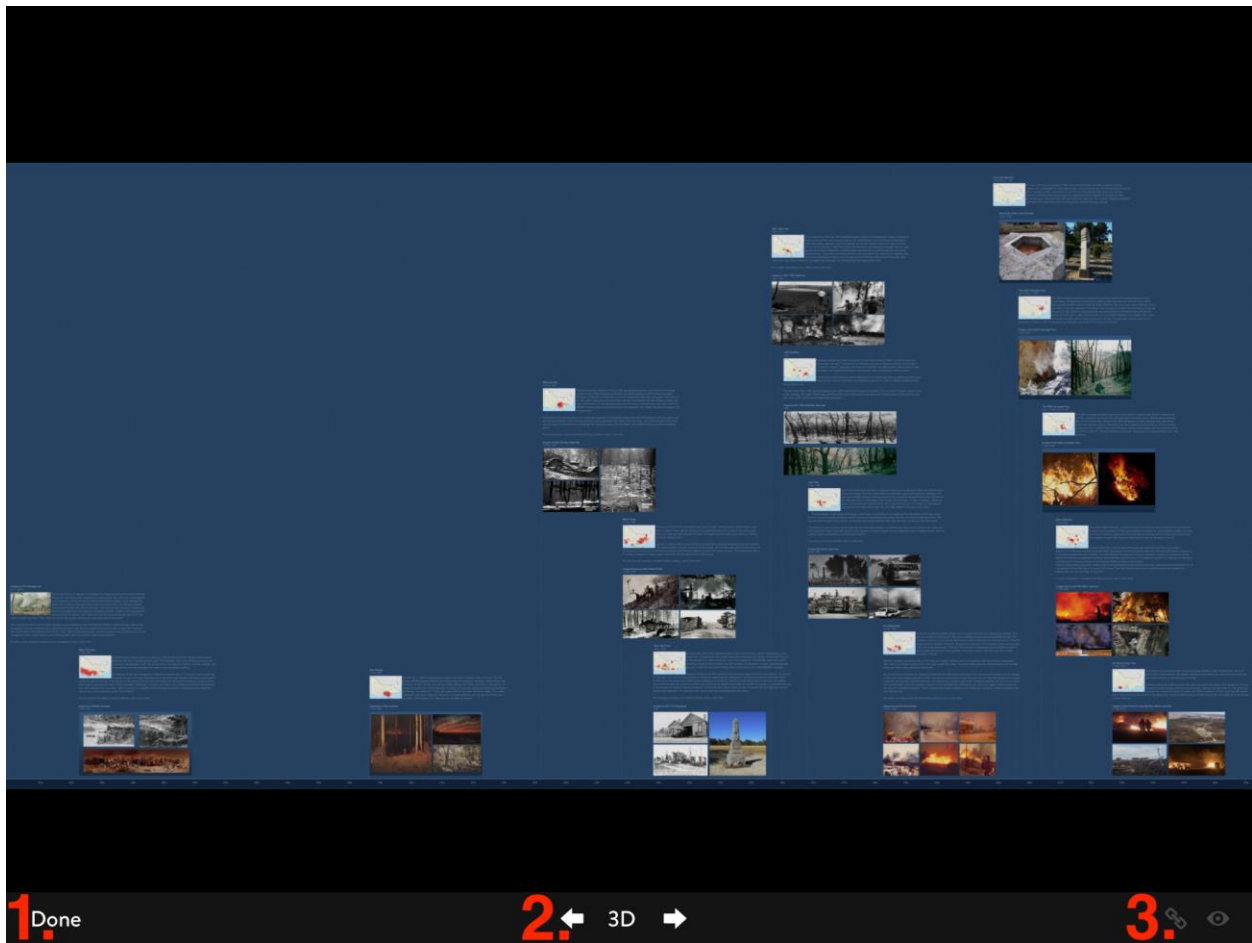
By tapping the bottom black part of timeline, a bar appears with a few options:
1. The Done button brings you back to the timeline edit screen.
2. The 3D button brings you up to the first event while the left and right arrows move you through the timeline.
3. The chain button allows to you look at a link within an event while the eye button allows you to zoom in on media/watch movies in each event.

The app also allows you to move through the timeline with finger movements.
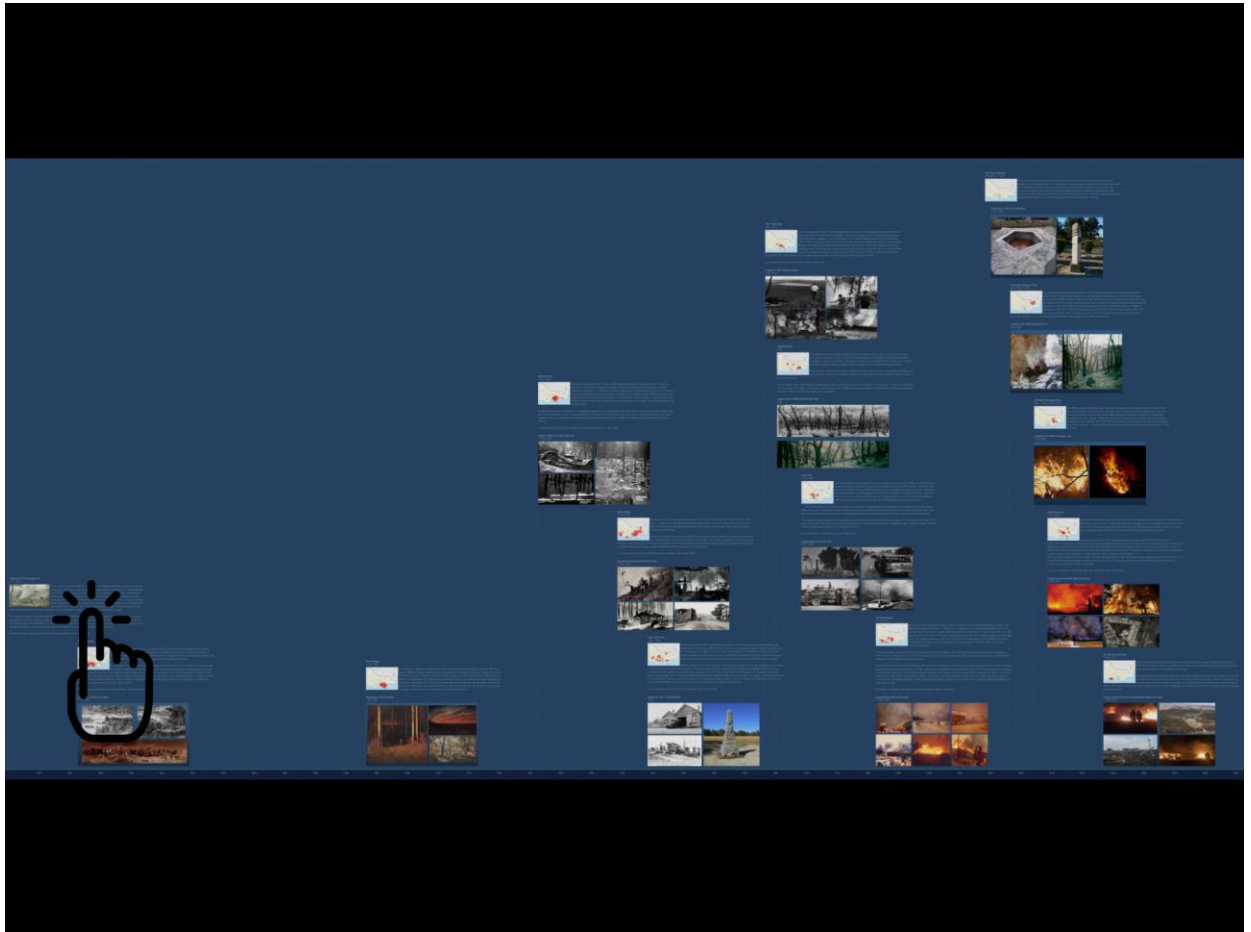
Tapping an event will bring you to the event.
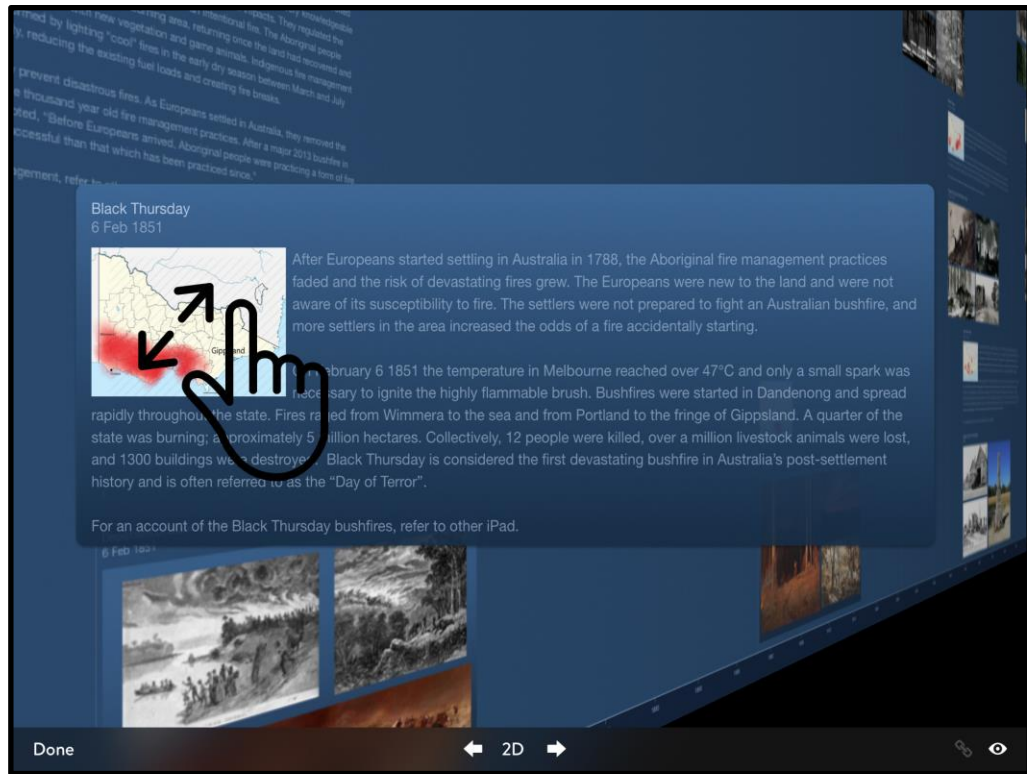
When on the event, you can zoom into the media/view movies by moving two fingers out as seen in the image above.
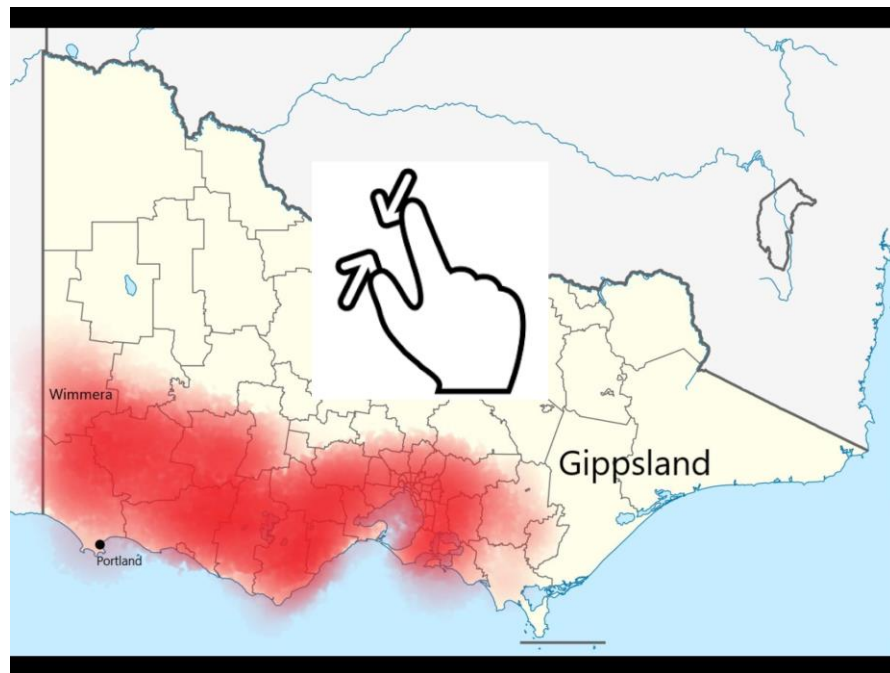
To get out of zoomed in media, move two fingers as seen in the image above. Doing this motion on the event will bring you to the overview of the timeline as well.
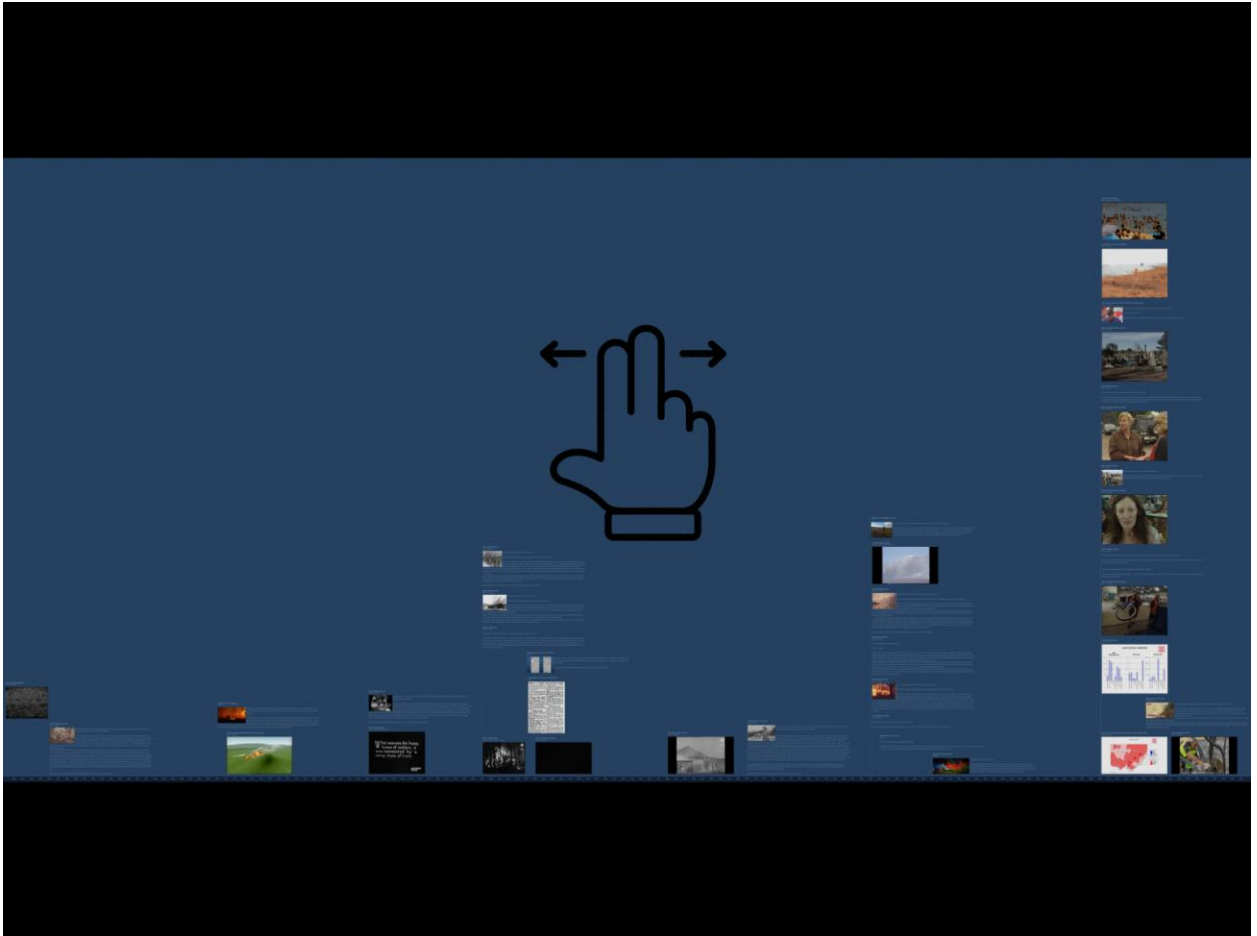
To move through the timeline, slide your finger to the left end of the screen to move right along the timeline and slide your finger to the right end of the screen to move left along the timeline.

2. Creating a Timeline

The previous section details how to configure and modify an existing timeline. These steps are applicable to both an old or brand-new timeline.
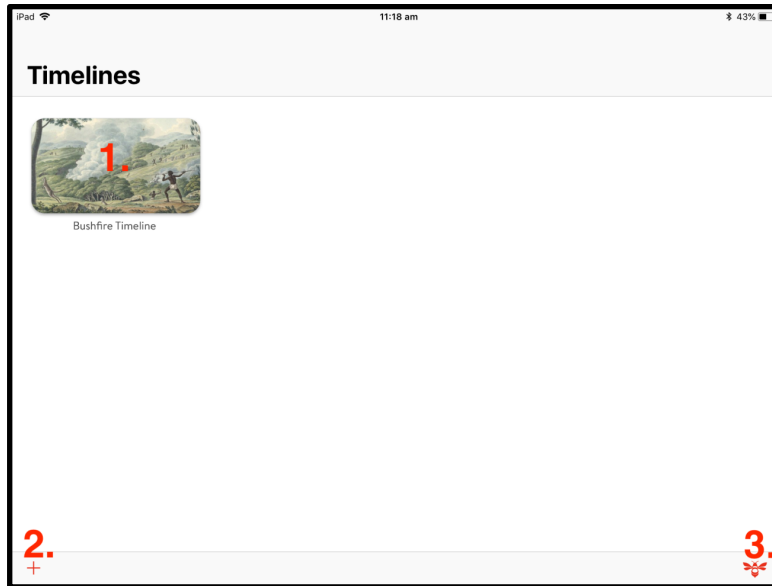
To create a new timeline, simply tap the *Add (+)* **button on the bottom of the main screen.** In the picture above, it is labelled as button *2*.
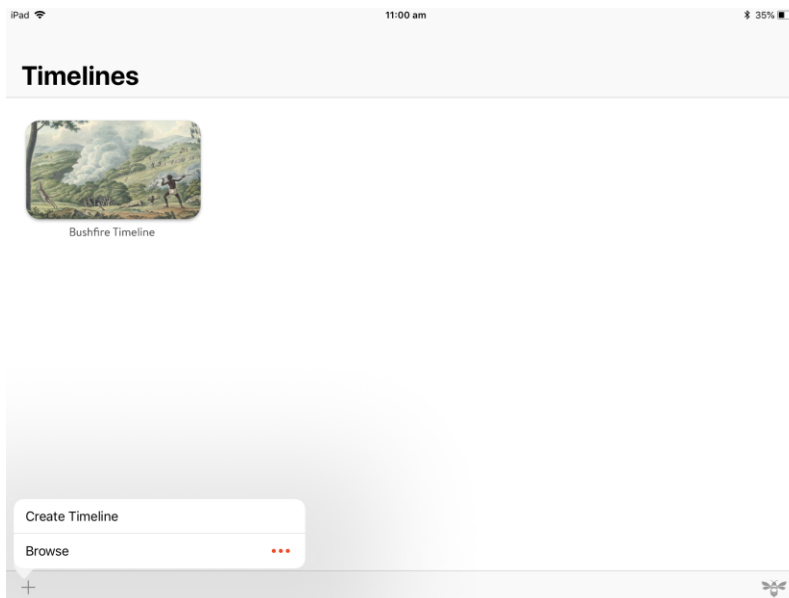
At least 2 options should appear: *Create Timeline* **and** *Browse.*

Create Timeline: After prompting to name the timeline, this option will create a new one, having it show on the main screen. This timeline can then be selected, and edited separately from any pre-existing timelines.

Browse: This option will open a file browser which useful for selecting an already-exported timeline data file. Selecting an already-exported timeline file will add the selected timeline to the iPad's application, allowing for the timelines to be transferable between devices.

3. BEEDOCS Contact

The following options are provided by the app's creator: BEEDOCS.
This includes, tutorials, website links, and a support email developed by BEEDOCS
BE AWARE SOME OF THIS CONTENT IS QUITE DATED AND WILL NOT BE APPLICABLE/WORK 100% OF THE TIME.
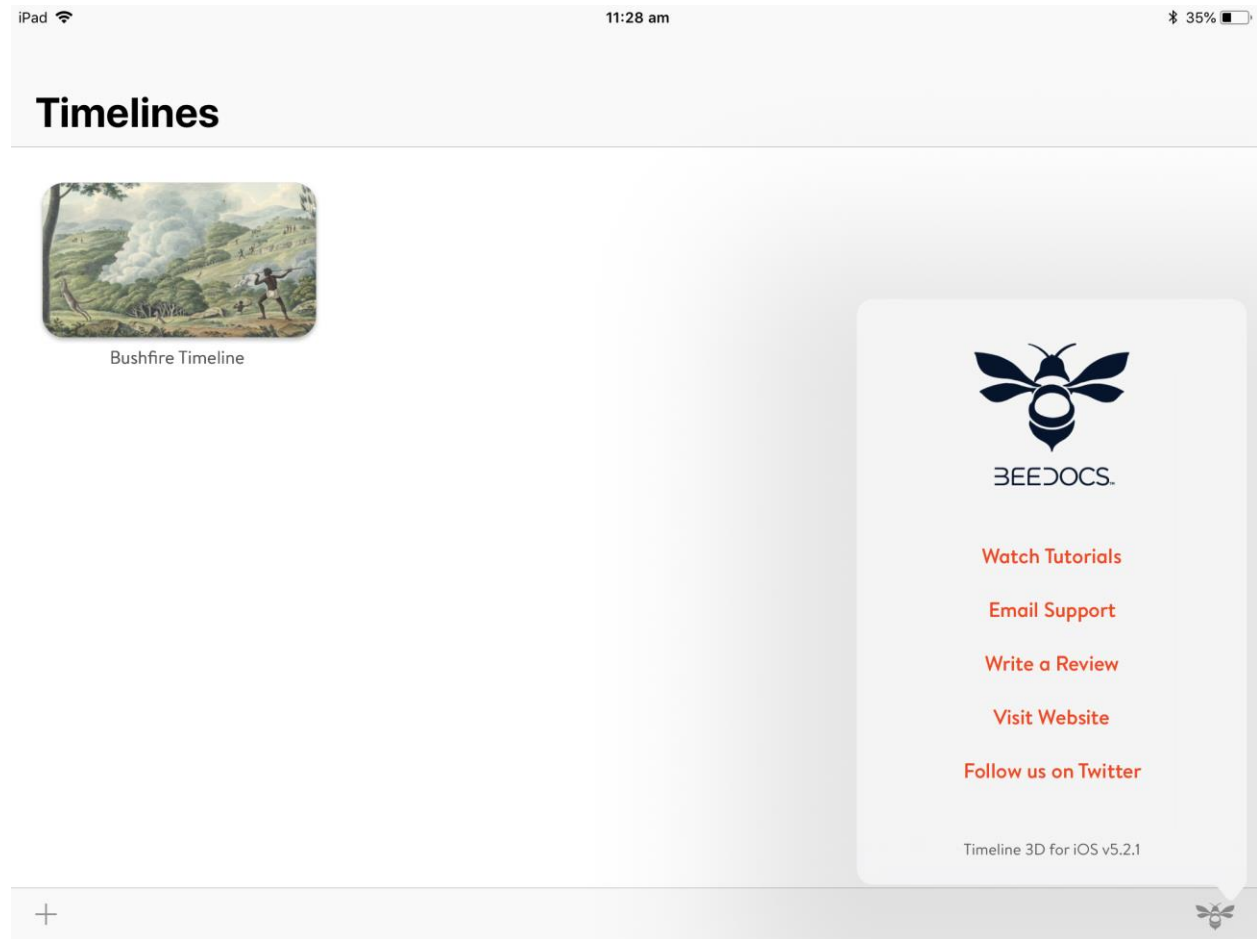
Appendix C: Exhibit Picture and Video Citations

Display pictures

- How Bushfires Start and Spread

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● <u>Peer Support</u>

Courtesy of CFA's Tim Fitzgerald

Courtesy of CFA's Tim Fitzgerald

Courtesy of CFA Facebook Page

Courtesy of CFA Facebook Page

Courtesy of CFA's Tim Fitzgerald

- <u>Black Friday and Black Saturday</u>

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    http://thewhizzer.blogspot.com/2006/01/black-friday-in-victoria-australia.html

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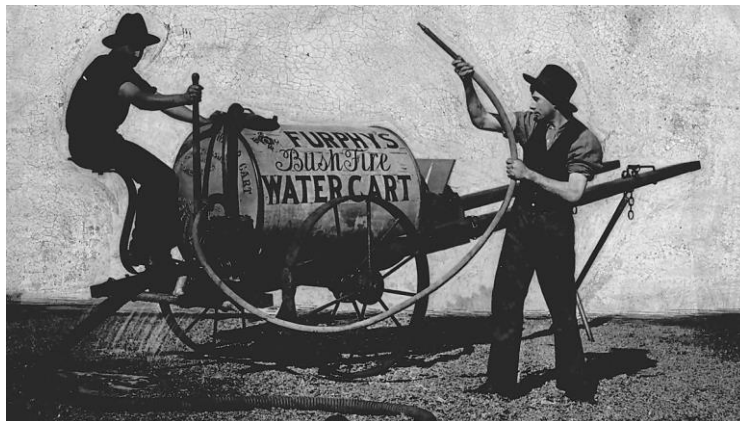
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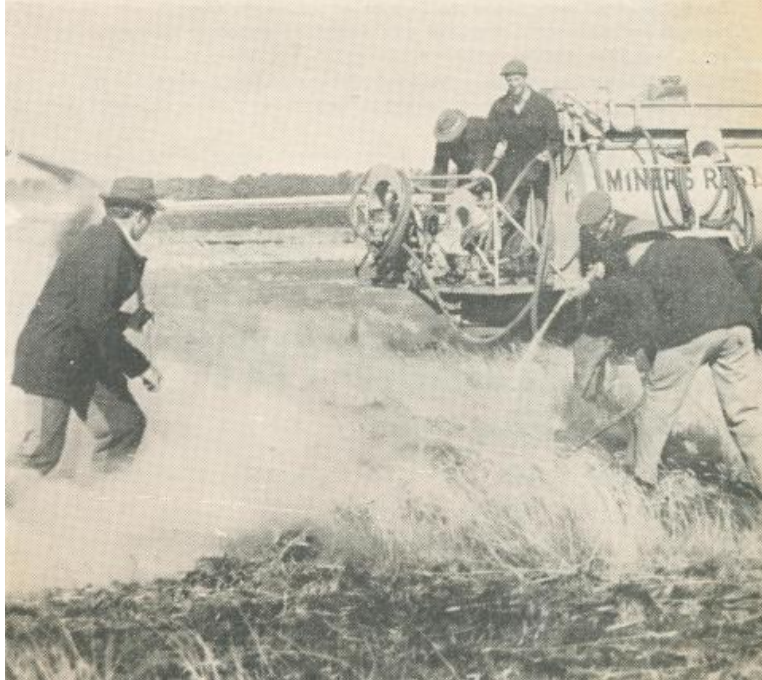
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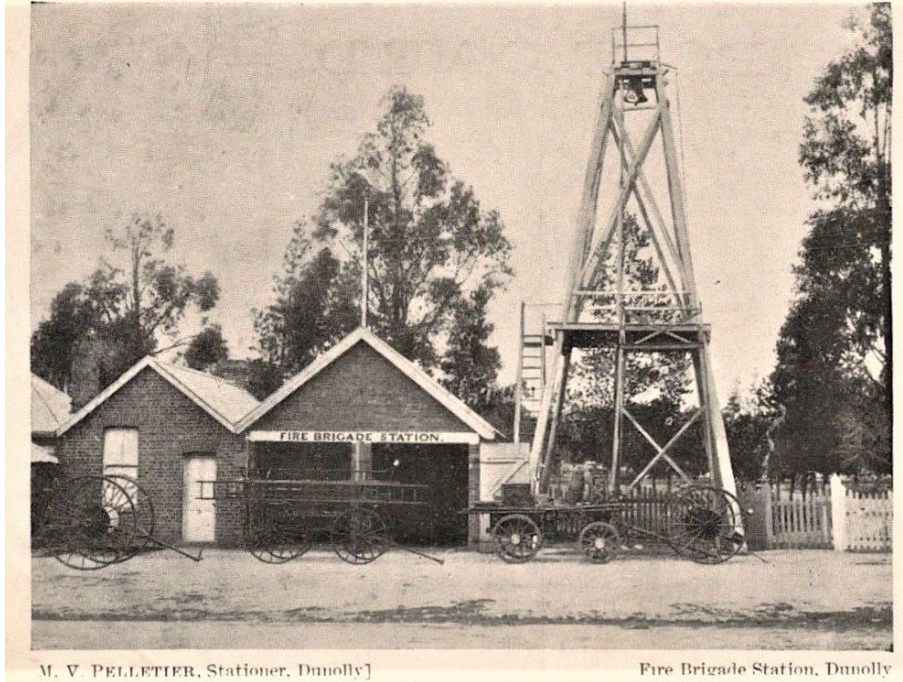
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marysville-cautionary-tale-sa-fire/6013114**

- <u>Picture Display</u>

Courtesy of CFA's Tim Fitzgerald

Sam the bushfire koala dies. (2009, August 06). Retrieved from

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Courtesy of Tim Fitzgerald

West, W. (2009, August 09). Perfect storm led to Black Saturday bushfires. Retrieved from
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Timeline Pictures

- <u>Black Thursday</u>

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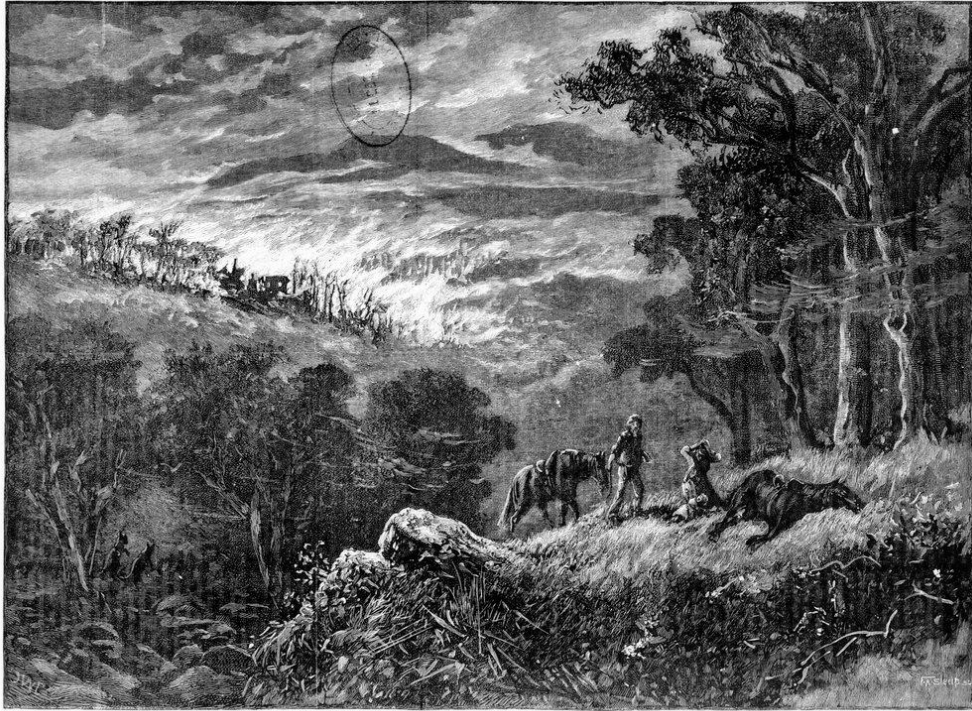
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Duncan, J. (2017, January 12), Suburbs in peril as deadly bushfires shocked Melbourne in 1962. *The Herald Sun***, Retrieved from**

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Alelis G., Bobrowitz A., and Ang. C. S. Exhibiting emotion: Capturing visitor's emotional responses of museum artefacts. In *Design, User Experience, and Usability. User Experience in Novel Technological Environments,* **429-438. Springer, 2013. (ref <u>30</u>)**

This paper reports on the results of a study carried out at the Powell-Cotton Museum, in south-east Kent, UK. Using structured interviews and thematic analysis, visitors' emotional responses to museum artifacts were documented and analyzed. The paper suggests that when given the task of providing emotional responses to artifacts, visitors are motivated to find meaningful and personal connections. This study was done to see how HCI (Human computer Interactions) affects the emotional links museum visitors make when viewing exhibits.

Over 18 individuals participated in the study and were all informed of the entire process when asked to participate. Each recorded their own emotional response when viewing exhibits/artifacts, in addition to participating in a one-on-one interview. The conclusion of the study suggested that when given the task of providing emotional responses to artifacts, visitors are motivated to find meaningful and personal connections without relying heavily on curators, exhibit labels, and arrangement of objects. In addition, seeing physical artifacts elicits a stronger, and overall more positive response compared to simple documentation.

This study is useful to our IQP group in developing the exhibit design, as well as providing factors that stimulate a more emotional response. Because our project's exhibit is featured around a subject that already elicits an emotional response, we want to make sure our exhibit conveys that effectively.

Another Bushfire Victim Dies. (1943, December 27). *The Argus***, p. 4. Retrieved October 30, 2018, from <u>https://trove.nla.gov.au/newspaper/article/11794845</u> (ref <u>17</u>)**

This source is a newspaper article written in December 27th, 1943, just 5 days after the grassland fire of Wangaratta burnt down the small village of Tarrawingee. The article's main purpose is to discuss the victims of the fire, as one community member has just lost his life. This

source explains exactly how the fire became so intense, with sudden and strong winds surprising firefighters as they battled the flames. The crew battling the fire tried to move their truck to safety when the heat caused the gas tank to explode, killing all firefighters inside.

Since the fire of Wangaratta seems to be overshadowed by larger fires in terms of information published on it, this newspaper article is valuable in providing us with a detailed description of how this disaster occured. The article includes the weather at the time of the fire, how many people died, and how these deaths occured. Also included in the article is how different disaster relief organizations at the time helped affected communities. This is useful information to us as one of our display boards is about fire services and how they have changed throughout the history of Victorian bushfires.

Australian Institute of Criminology. (2017, November 03). Cost of bushfires.
https://aic.gov.au/publications/bfab/bfab060 (ref 16, 24)

This article discusses the cost bushfires caused to Australia. With 552 people dying in bushfires in the past century (according to witness, police statements, and coronal data), bushfires are the leading cause of death from natural disasters in Australia. In an average year (since 1939), there are AUD 80-100 million in insurable losses. However, some years such as 1939 with the Black Friday fires, Australia experienced AUD 750 million in insurable losses (losses covered by insurance).

This article is relevant to the social impacts section of our paper. Although brief, this article helps us understand the magnitude of bushfires. While AUD 100 million is the average annual expense caused by bushfires, sometimes a massive fire can cause up to 7 or 8 times that amount in losses. This information will be used in our background section when discussing the social impacts bushfires have on communities.

Black Sunday. (n.d.). Australian Screen: An NFSA Website. Retrieved from
https://aso.gov.au/titles/documentaries/black-sunday/clip1/ (ref 14)

This webpage contains a 3-part education video on the Black Sunday fires of 1926. This video which was created by the Education Services Australia contains textual information in

addition to video providing a great deal of information. In addition to stats on land burned, location, and fatalities, the webpage delves into the weather at the time of the tragedy. It discusses how fires have been occuring all summer and on February 14th it was exceptionally hot. Once the wind reached speeds up to 97 km/h, groups of fires merged creating an out-of-control bushfire. The video details which communities suffered the highest number of fatalities and how each community was affected differently.

This video notes that these fires were the fault of graziers as they set fires to aid grass growth for their cattle. This information is included in our interactive timeline as one of the factors that causes bushfires in Australia. One of our goals is to educate visitors of our exhibit on bushfires. If we can show that not all bushfires occur naturally, it will encourage people to think about their actions before they risk starting a fire.

Bowman, D. (2018, September 19). Aboriginal fire management – part of the solution to destructive bushfires. Retrieved from https://theconversation.com/aboriginal-fire-management-part-of-the-solution-to-destructive-bushfires-55032 (ref 12)

This article in *The Conversation* discusses the value of Aboriginal fire management and compares the current fire management practiced today to the Aboriginal one. The article also claims that most Aboriginal tribes used the same methods for fire management. There is not much information on the Aboriginal practices, but there is concrete evidence that the Aboriginal fire management altered the Australian ecosystem. This source is valuable because our exhibit will explain how European settlement in Australia forced out successful Aboriginal fire management contributing to many devastating bushfires.

Bradstock, R., & Gill, A. (1994, September). Survival of serotinous seedbanks during bushfires: Comparative studies of Hakea species from southeastern Australia. Retrieved from https://doi.org/10.1111/j.1442-9993.1994.tb00490.x. (ref 8)

This study conducted in 1994 looked at six serotinous Hakea species in the Sydney, Australia region to see the survival rate of these different types of fruits in intense heats.

Serotinous Hakea species are fruits whose seeds have genetically evolved over the years to withstand intense heat produced by bushfires. The study tried to determine which types of species were most heat resistant with the ability to reproduce after bushfires. The results of the experiment were that the smaller the fruit, and the thinner the fruit walls were, the less likely the seeds inside were capable of reproducing. When fire temperatures reached higher than 400°C outside and 60°C inside the fruit, the heat-resistant seeds began to die. The article notes that although these seeds do succumb to extreme heat, most bushfires only reach such high temperatures when the bush crowns burn. In most cases, the seeds will remain alive and reproduce after bushfires.

Bryant, C. (2008). Understanding bushfire: Trends in deliberate vegetation fires in Australia. https://aic.gov.au/sites/default/files/publications/tbp/downloads/tbp027_01_introduction.pdf

This publication explains the difference between deliberate and natural vegetation fires. The cause of fires is labeled in the two categories. The article starts by stating that Australia is the most prone to fires out of all the continents. Humans cause disruptions in the natural cycle of bushfires. The article also describes for each jurisdiction the urban, rural, and land management agency responsible for alleviating wildfires in Australia. The primary purpose of the article is to determine plausible percentages of deliberate firesetting in Australia. The data is gathered from several fire agencies all around Australia. This data contributes toward assisting the Australian government to determine what activities to regulate to prevent future fires.

Bushfire Basics. (n.d.). Retrieved from http://www.ga.gov.au/scientific-topics/hazards/bushfire/basics (ref 5, 6)

This article in the Australian Government - Geoscience Australia website/archive?, discusses the reasons behind why Australia is so prone to fire. The article provides information of the different types of wildfires that are common in Australia, grassfires and bushfires, and explains the difference between them. The article discusses the different factors that influence the intensity of fire, such as fuel loads, winds, land moisture, slope angle and more.

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Bushfire Education Foundation, Bushfires in our History, 1969 - Lara Fire. (2014).
Retrieved from http://www.bef.net.au/LaraFire.htm (ref 19)

This source is derived from the Bushfire Education Foundation, a foundation which is aimed towards discussing the risk posed by fires in public forums and with school students. The article only gives a brief description of the fires, however it is useful as general information such as losses, and areas affected is included. The founder of the organization, Thomas Barry, was present at the Lara fires as a cameraman, and was inspired to develop the organization and website for educational purposes. The site also has some useful general information regarding other major bushfires that occurred in Victoria.

Bushfire Red Tuesday. (n.d.). Retrieved October 30, 2018, from
https://knowledge.aidr.org.au/resources/bushfire-red-tuesday/

The main focus of this webpage is to provide statistics on the Red Tuesday fires which occurred in February of 1898. This short, yet informational page identifies where the fires occurred, how much land was burnt, and how many people died. Additionally this website created a map of where the Red Tuesday fires occurred, residing just east of Melbourne.

This source provided us with information necessary for our background research on Red Tuesday which is included in our interactive timeline. Since these fires occured in 1898, there was very little primary sources that we were able to find on these fires. This webpage contained valuable information as well as two detailed paintings depicting the fires which we implemented in our timeline. We used these pictures in our timeline as they best represent the Red Tuesday fires.

Bushfires in Our History, 1851 - 2009. (n.d.). Retrieved from
https://www.bushfireeducation.vic.edu.au/verve/_resources/Bushfires_in_our_History.pdf (ref 18)

This bushfire education chart describes the major bushfires that have occured in Victoria's history. The chart starts with the Black Thursday fires that occured in 1851 and goes to the Black Saturday fires of 2009. The duration of each fire, nickname, locations, deaths, property losses, area burned, and general information is recorded. This information is very useful for our interactive timeline as it lists several fires from 1851 to 2009 which covers most of our timeline. The chart came from the Victorian Government and was compiled from the Department of Sustainability and Environment.

CFA. (2003). *The Campaign Fires*(2003 ed., North-East/East Gippsland Fires). Mt Waverley, VIC: CFA. (ref <u>22</u>)

The main focus of this book is to provide information on the 2003 campaign fires which occurred from January to March of 2003. This detailed book identifies where the fire occurred, how much land was burnt, and how many people died. Additionally, this book presented a map of where the fires occurred, in the mountain regions of Victoria.

This source provided us with information necessary for our background research on the 2003 campaign fires included in our interactive timeline. This book also contained several pictures and quotes from firefighters and citizens.

Community Bushfire Connection. (2006). 2006 Coopers Creek and Great Divide Fires. Retrieved from <u>https://www.communitybushfireconnection.com.au/2006-coopers-creek-great-divide-fires/</u> (ref <u>23</u>).

The main focus of this source is to provide information on the 2006 campaign fires which occurred from December 2006 to February of 2007. This detailed website identifies where the fire occurred, how much land was burnt, and how many people died. Additionally this website provides a map of where the fires occurred in eastern Victoria.

This source provided us with information necessary for our background research on the 2006 campaign fires which is included in our interactive timeline. This website contained valuable information such as the direction and start of the fires.

Connick, R., McCloskey, N., Phinney, B. (2010, April 30). *Bushfire Warning Systems in Australia*. **Melbourne Project Center. (ref <u>23</u>)**

This IQP studied the changes in wildfire policies and warning systems in Australia due to the Black Saturday fires (2009). Before the Black Saturday fires, the standard policy during wildfires in Australia was "Stay and Go". For decades, this policy encouraged citizens to protect their home until it was too dangerous to do so. Unfortunately, many people were not prepared to fight a fire of this scale, and it was unclear when the proper time was to leave. The 2009 fires resulted in the largest number of casualties from a wildfire in Australia, thus, there was a need to revise the policy and improve the fire warning systems across all states. The Australian Government then enacted the "Prepare, Act, Survive" policy which taught Australians how to properly fight a fire and when the correct time is to leave your home. To improve this new policy, the IQP team studied how different fire brigades across Australia planned to put this policy into action. By conducting interviews and surveys they were able to give recommendations relating to the "Prepare, Act, Survive" policy, educational programs, and fire warning systems.

This report is of importance to us because it shows the impact the 2009 fires had on a governmental level. After decades of following a policy, one fire led to change. This provides us with another aspect that should be considered in our background section when discussing the Black Saturday fires. Since the project was done by an IQP team, this allows us to build-off of our peers' work. The report also includes information about many wildfires that took place in Australia that are featured in our interactive timeline.

Corbin, T. A. (2011, January 24). Short-term effects of a wildfire on the water quality and macroinvertebrate community of a saline stream. *International Journal of Wildland Fire 21***(5), 537-544.** <u>https://doi.org/10.1071/WF11014</u> **(ref <u>7</u>)**

This source is about an experiment conducted in Eyre Peninsula of South Australia to study the effects wildfires have on streams in the area. The study looked at the before and after fire data of nitrogen, phosphorus, color, turbidity, suspended solids, and organic carbon found in rivers and streams. The group also collected and analyzed macroinvertebrate in the water. The

results they found were pretty surprising to them as they found no noticeable change in water conditions a year after a wildfire. Some changes in water color and nitrogen/phosphorus concentrations were noticed up to three months after fires, but these all returned to normal shortly after. The group attributes this to the lack of rain during the fire for not transporting any toxins into the streams.

This article was chosen so that we could better understand the environmental impacts fires in Australia had. Although this experiment does not help us much in terms of designing a museum exhibit, it does give us valuable information on how bushfires affect Australia. We now know how the dry climate that causes these fires also helps keep the rivers and streams free of toxins that lay on the ground after a fire.

Country Fire Authority. (2011, April). Ash Wednesday. Retrieved from https://www.cfa.vic.gov.au/.../Ash-Wednesday.../df7684b9-66a1-00c4-2154-5b986c6… (ref 22)

This source provides an overview of the Ash Wednesday bushfires. The bushfires swept through parts of Victoria and South Australia. From April 1982 to January 1983 there was a horrible drought with little rainfall. On the day of the first fire, the temperature came out to 43 °C. About 180 individual fires broke out on February 16th, 1983. The fires started due to power lines hitting each other and sparking, tree branches hitting power lines, and people deliberately lighting fires. The fires in Victoria burned a total of 200,000 hectares. People lost hundreds of homes along with equipment, machinery, and livestock. 75 lives were lost in the bushfires. Most fires were controlled on the same day, some even in two to eight hours. Taking down the fires all depended on if they were easily accessible. Some fires took longer to combat due to no road access and being in mountainous regions.

This source is important to our paper as it describes the Ash Wednesday bushfires. This fire resulted in the second most amount of lives lost in bushfires, so it is important that we include it. This source is from Victoria's Country Fire Authority.

Country Fire Authority. (2018). *CFA Strategy Towards Resilience 2013-2018*[Brochure]. Melbourne, VIC. (ref 9)

This document written by the Country Fire Authority discusses the responsibilities of the CFA and the strategies it will employ to create a more resilient Victorian community. Some of the goals the CFA set for itself include the following: reduce the incidence and impact of fire emergencies on the community of Victoria, reduce the impact of non-fire emergencies on the community of Victoria, be a highly trusted and respected fire and emergency service, and increase community resilience to fire and non-fire emergencies in Victoria. This report is essential for our understanding of the bushfire community resilience and the current CFA operations.

The Courier. (2002, January 11). Linton inquest findings. Retrieved from https://www.thecourier.com.au/story/323255/linton-inquest-findings/ (ref 22)

This source explains what happened on the day of the Linton Bushfire in detail. The article explains the number of firefighters involved the fire, what towns came to help, where the fire was, and the amount of damage and lives lost. The bushfire is a very sensitive topic as five CFA firefighters passed away after being trapped in the fire.

The source is relevant to our paper as it provides us with information for our interactive timeline and in great detail. The site also explains the aftermath of the fire and what policies were put in place after the fire.

**Cutler, S. (2013). Building better boots and gear for firefighters: 3-D technology sheds new light on hazards of bulky garb. Human Ecology, 41(1), 13.
Retrieved from
http://link.galegroup.com/apps/doc/A335842837/AONE?u=mlin_c_worpoly&sid=AONE&xid=3611f8ec (ref 28)**

This is a Cornell University study on the functionality and comfort provided by fire gear. As noted in the article, fire technology has come a long way in terms of predicting the behavior of fires and fighting them. However, the gear the firefighters wear are grossly outdated and can even be the cause of injury on the job. The study's goal was to make firefighters' movements more natural and comfortable by designing better fitting gear. Through the use of force sensors

and motion capture software, the team's study was able to determine what parts of firefighters' boots make them off balance and uncomfortable. They plan on 3-D printing a prototype of their newly designed boot to be tested for comfort and functionality.

This study, although not related to the fires we are dealing with, provides valuable insight into the advancements of fire technology. Our sponsor would like us to briefly review the differences between firefighting technology used in recent fires compared to fires 100 years ago. This article contained information on some of the old technology firefighters used such as their gas masks. They pumped air through a hose to a bulky face mask which would allow them to breathe in fires. Many firefighters decided not to use these masks because they got in the way of their movements. It also talked about how firefighting helmets and gear has changed from leather to metal, plastic, and advanced materials. We used some of the information in this article to create a more informative exhibit.

Darcy, S. (2018, October 31). Personal Interview (ref <u>10</u>, <u>11</u>)

This interview conducted on October 31st, 2018 with Scott Darcy, co-coordinator of the peer support program for the MFB (Metropolitan Fire Brigade), provided our project with valuable insight into how the MFB helps promote positive mental health within its firefighting team. In addition, Mr. Darcy took part in the fighting of the Black Saturday fires. He was able to provide us with specific dates and facts about both the peer support network and certain events regarding the Black Saturday fires. His information is used in our exhibit displays including information he said about the Black Saturday fires that captured the magnitude of the event.

Doerr, S. H., & Santín, C. (2016, June 05). Global trends in wildfire and its impacts: Perceptions versus realities in a changing world. Retrieved September 11, 2018, from <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4874420/</u> (ref <u>3</u>, <u>4</u>)

This article is a part of a larger journal collection called 'The interaction of fire and mankind'. In terms of information, this article presents global statistics about wildfires and their impact on human society. It discusses the differences between what the media considers a

"good" wildfire in comparison to a "bad" wildfire (i.e. a fire that mostly benefits the environmental system versus a fire that primarily causes societal damage). The article discusses statistics involving the impact of modern climate change and urban environments on wildfire occurrences, as well as the physical and societal health and monetary complications that come with wildfires (globally). The article contains a variety of sources from which the author drew their statistical information; increasing the credibility of the article. In discussing these issues, the main focus of the article was to analyze the global trend in wildfire impacts. The article concluded that data does not support the perception of increasing direct losses from fire. Over the past decades, there was no clear trend of increasing direct losses such as losses of life or infrastructure. While any fire-related death can be seen as one too many, at least the risk of direct death from fire for the population as a whole is low compared with other natural hazards. This is in part due to the media's increasing communicative capabilities blowing wildfire impacts out of proportion in comparison to previous events within fire-prone areas.

The statistical data gathered from this article is useful in our background section in detailing the impact and implications a wildfire has on a society and the surrounding environment. While we are not necessarily analyzing current wildfire trends, the information that the article uses is helpful in understanding the impact wildfires have on a global scale.

Duncan, J. (2016, November 21). The 1969 Lara grass fire killed 17 people, and high risk of more deadly grass fires this summer. *The Herald Sun*, Retrieved from https://www.heraldsun.com.au/news/victoria/the-1969-lara-grass-fire-killed-17-people-and-high-risk-of-more-deadly-grass-fires-this-summer/news-story/8af3f02fabcd57779181effabd9eaefa (ref 19)

This newspaper article written for the *Herald Sun* newspaper in 2016 is a reflection on the 1969 Lara fires. The article includes interviews with Thomas Barry, a cameraman that reported on the fires in 1969, as well as Emergency Management Commissioner Craig Lapsley. The article discusses the start of the fire, as well as the casualties and impact left by it. The article also emphasizes the change in bushfire-automobile interaction procedures, as most individuals killed by the fire were either trapped, or seen not far from their motor vehicles (the fire occurred on Princes Highway). Relevant quotes describing the fire are present, with

information that can be used as background-section info, as well as Lara bushfire information to be used in the interactive timeline.

Duran, F., Woodhams, J., & Bishopp, D. (2018, February 22). An Interview Study of the Experiences of Firefighters in Regard to Psychological Contract and Stressors. Retrieved from https://link.springer.com/article/10.1007/s10672-018-9314-z\ (ref 10)

This study observed and recorded firefighters' beliefs and experiences about the psychological contract between themselves as employees and their employer, workplace stress, stress-management strategies and their wellbeing. Interviews with eleven active UK firefighters were analyzed, with responses being divided into five overarching themes: Motives, Mutual Obligations, Stressors, Moderators, and Retention factors.

Firefighters are exposed to a range of demands that impact their somatic and mental wellbeing. A multitude of incident-related stressors faced by Fire Service personnel can affect their mental and physical health. This includes time, pressure, lack of sleep, fatigue, high stakes decision making, the risk of injury to self or death, and exposure to other people's trauma. Large-scale wildfires can increase the effects of these stressors, often leading to the onset of Post-Traumatic Stress Disorder (PTSD).

This source is useful to include because it discusses the impacts that firefighting can have on the individuals we interviewed, as well as the social impact caused by fires. (An aspect we present in our exhibit).

Dwyer, G., & Hardy, C. (2016). We have not lived long enough: Sensemaking and learning from bushfire in Australia. http://journals.sagepub.com/doi/pdf/10.1177/1350507615577047

This article explains how people of Australia have dealt with the Black Friday, Black Saturday, and Ash Wednesday bushfires. The article focuses on the themes in talks about bushfires. Some of the themes include novelty, sensemaking, single loop learning, and double loop learning. The mental effects of the bushfires and what mental illnesses arise from it are present in the article as well. An issue discussed in the article is how the youth will learn about

bushfires and understand the consequences of setting fires off. If the youth is not properly taught about bushfires, then history will repeat itself and more deliberate bushfires will happen. The article states the most common reasons Australians thought the three largest fires started. These reasons mainly consisted of drought, hot weather conditions, and lack of effective organizational control and accountability. The article discusses how these opinions were obtained by Australians, and what the general populace believes caused the variety of terrible fires.

This journal relates to our IQP because we needed to determine how to portray our museum exhibit to Australians. Getting an understanding of how Australians feel about the fire is important so could express that in the exhibit's content. It is also important to make sure our exhibit allows people who did not know about the fires to learn what happened and understand not to deliberately set off fires to cause destruction. With this information, our group is more aware of some of the emotions felt from these fires.

Elmir, R., Schmied, V., Jackson, D., & Wilkes, L. (2010, September 9). Interviewing people about potentially sensitive topics. https://pdfs.semanticscholar.org/ec96/86a8d09b019e6919f4e790160d5f11740074.pdf (ref 28)

The purpose of this article was to explain how to facilitate an interview on sensitive topics. A couple of techniques are explained that could potentially work when talking to the participant. Some of the techniques include using computer-mediated communication, creating a participant-interviewer relationship, developing rapport, minimizing power imbalances, use small talk, and demonstrate care and empathy. The idea is to make the participant feel comfortable sharing personal information about their experiences. If the interviewee does not feel comfortable, they may give little or no information. The article also suggests to allow the participant to have time to express feelings and remain silent as speaking of sensitive topics can cause great emotional responses.

This article relates to our IQP because we interviewed people who had experienced and dealt with the fires first hand. We wanted to understand how to approach the interviews so that participants feel comfortable sharing their experiences, as traumatic events such as wildfires

leave people mental illnesses such as PTSD. This article also helps us gain an understanding of the process of an interview relating to sensitive topics.

Fire and Rescue, Intelligence gathering: global warming is changing the nature of wildfires but the advancing technology of drones and fire-prediction software is helping fire services keep pace with the threat. Jemma Dempsey reports. (2017, May). 49+. Retrieved from http://link.galegroup.com/apps/doc/A494891089/AONE?u=mlin_c_worpoly&sid=AONE&xid=f52c06f5 (ref 27)

This article contains information on how drones and other advances in programming technology are helping firefighters fight wildfires in a much safer manner. When fire servicemen combat wildfires, they face many dangers including wind shifts which can trap them inside the inferno. Fires and the way they move are unpredictable because winds can shift with no warning. Drones with complex programs are now being used to survey wildfires before human lives are put at risk. They can provide real-time data of wind speed and direction as well as how the fires are behaving. Thermal imaging cameras can also be used to detect hot spots where firefighters need to focus on. In Australia, the *Australis* drone can relay information back to firefighters in safety without internet connections. The program can predict fire movement in a similar way to how programs attempt to predict the weather. These advances in technology greatly improve the safety of firefighters as they no longer must blindly fight fires at the mercy of mother nature.

This source is very useful to our background research and is incorporated in our exhibit to portray how firefighting technology has improved over the years in the form of FSMV artifacts. The article talks specifically about how technology that was initially not intended for firefighter use is now being implemented in a way that saves lives. While the main topics for our exhibit shifted away from firefighting technology specifically, we still show technology development in the form of FSMV artifacts.

Fire Services Museum of Victoria, FSMV - About Us. (2013). Retrieved from http://www.fsmv.net.au/ (ref: 1, 3)

The purpose of this source is to inform the public about what is the Fire Services Museum of Victoria (FSMV). The FSMV focuses on displaying and preserving artifacts of fire-fighting in Victoria, and all around the world. The collection of artifacts is over 10,000 from both Australia and worldwide. The museum itself is an exhibit with the building being the original headquarters of the Metropolitan Fire Brigade. The museum opened its doors in 1979. All of the people that work at the museum are volunteers with some that are retired or current firefighters. Some other volunteers come from fire-related agencies such as the Department of Environment and Primary Industries. The museum is open to the public on Thursdays, Fridays, and Sundays.

The importance of this source is to understand the sponsor organization. By looking at the website, we can understand the common design of the museum and what the focus of the fire-fighting history is.

Fire Services Museum Victoria Major Fires Index (FSMV Index), Major fires in Victoria 1851-1987. (ref 13, 15, 17, 18, 19, 28)

This is an index of all major fires that occured in the state of Victoria between 1851 and 1987. The index was supplied to us by our sponsor, the Fire Services Museum of Victoria. The index itself contains the names, dates, locations, losses, and other general information describing the fires which took place within the time interval. This information is essential to our bushfire timeline.

Forest Fire Management Victoria. (2017, June 10). Black Friday 1939. https://www.ffm.vic.gov.au/history-and-incidents/black-friday-1939 (ref: 1, 15)

This article explains the Black Friday fires in detail. Black Friday occurred on January 13th, 1939 and ended two days later after a rainstorm. The fire started after a long, dry, hot summer followed by a drought for several years. The fire started out as several small fires and eventually all combined together. The fire burned through 2 million hectares of land. Thousands of sheep, cattle, and horses were killed by the fires. Valuable timber such as Mountain Ash was destroyed in reserved forests. The ash from the fires traveled as far as New Zealand. Over 1,000

homes and 69 sawmills were burned. The fires affected the soil so much that it took the soil chemistry decades to get back to its natural state.

This article is relevant to our IQP because it describes one of the fires that is the main focus of our exhibit. Our task was to display the Black Friday fires for people who might not know about the fires and commemorate the people who helped fight the fires. A special emphasis is made on the firefighters who risked their lives to extinguish the fires. Understanding the background information about the Black Friday fires was crucial in developing the exhibit's content.

Gamble, L. (n.d.). The Beaumaris Bushfires of 1944. Retrieved from http://localhistory.kingston.vic.gov.au/htm/article/319.htm (ref 16, 18)

This article on the Kingston Historical Website tells the story of the summer fires of 1943-44. The article includes information on how the fires started, what areas were affected, personal accounts, and the formation of the Country Fire Authority. The article focuses on the struggle of fighting these fires, as many men were away on duty during WWII. The article describes in great detail how the fires moved across the state, and the difficulties of fighting the fires. For example, in the town Beaumaris, there was a problem of access to the fire front. Beaumaris at the time was rural in appearance as most of its streets were sandy tracks with trees overhanging what passed for roadways. Not only did this make it hard to get vehicles into the area but it added fuel for the fire, both overhead and on the ground where dead leaves accumulated, increasing the intensity of the blaze.

General Network Information. (n.d.). Retrieved November 8, 2018, from https://web.archive.org/web/20090212062627/http://users.sa.chariot.net.au/~mattb/scan/grninfo.htm (ref 21)

This source provides information on how the Government Radio Network (GRN) was established in Victoria after the Ash Wednesday bushfires. It provides information on what the GRN is and how it can effectively provide first responders, firefighters, and police officers with a more reliable network to communicate through. This source also included some documents

from the Southern Australian Parliament regarding the formation of the GRN. Knowledge on the GRN is important to our project because it is one example (besides the peer support system) of how the Ash Wednesday fires created positive changes in the Victorian area.

Gibbs L, & Bryant R, & Harms L, & Forbes D, & Block K, & Gallagher HC, & Ireton G, & Richardson J, & Pattison P, & MacDougall C, & Lusher D, & Baker E, Kellett C, & Pirrone A, & Molyneaux R, & Kosta L, & Brady K, & Lok M, & Van Kessell G, & Waters E. (2016, November). *Beyond Bushfires: Community Resilience and Recovery Final Report.*, **University of Melbourne, Victoria, Australia. https://beyondbushfires.org.au/__data/assets/pdf_file/0010/2198134/V3_Beyond-Bushfires-Final-Report-2016.pdf**

Beyond Bushfires is a 5 year-long study that was conducted by the University of Melbourne which analyzed the social impacts of the 2009 bushfires (Black Saturday) that happened in the state of Victoria. The group studied the long-term implication of the fires on the mental health and social relationships of members of different communities in Victoria by surveying and conducting interviews. The report also includes quotes from several people which make it more personal and meaningful.

This source is credible since the study was done by an educational organization. The university also partnered with other governmental, community, emergency, and service agencies. In addition, it is important to emphasize that the study was conducted over several years, showing the change of data over time.

The report is relevant to our project because it provides a significant study that was done on the social impacts of the 2009 fires. It provides valuable information for our background chapter and helps us better understand the significance of the fires to citizens of Australia.

Grant, B. L. (April 04, 2018). Eucalyptus Fire Hazards: Are Eucalyptus Trees Flammable. Retrieved from https://www.gardeningknowhow.com/ornamental/trees/eucalyptus/eucalyptus-fire-hazards.htm (ref 16)

This article in the gardening website discusses why the eucalyptus tree is flammable and notes that the eucalyptus tree evolved to easily regrow after burning. The article explains that the easy recovery of the tree added with its volatile oily glasses, make it a potentially threatening species for forests in which the eucalyptus tree is abundant, such as in Australia.

Griffiths, T. (1992). Secrets of the forest: Discovering history in Melbourne's Ash Range. Retrieved from http://www.emelbourne.net.au/biogs/EM00270b.htm (ref 18)

This article gives a broad overview of bushfire history in Victoria. The article starts by calling Melbourne the capital of one of the most fire-prone territories in the world. The practice of Aboriginal burning is described and how it transformed the landscape. Several major fires are stated and the Black Friday fires are briefly described. The importance of this source is the information about the January 1962 fire in the Dandenong Ranges. The information stated about the 1962 fire is very useful for describing the fire in our interactive timeline. This source is reliable as it is published by the School of Historical and Philosophical Studies at the University of Melbourne. The article is also referenced to Tom Griffiths who wrote *Secrets of the forest: Discovering history in Melbourne's Ash Range*.

Hall, R., ABC TV, & ABC. (2017, April 12). Ash Wednesday: 'A glimpse inside hell'. Retrieved from https://www.abc.net.au/news/emergency/2013-02-14/ash-wednesday-bushfires-1983-from-the-archives/4519214 (ref 20)

This source explains the Ash Wednesday bushfires which occured on February 16th, 1983. The first fires started in Adelaide in the morning. The conditions for fires to move rapidly came about from a build up of a heat wave and a 10 month drought prior to the start of the fires. On the day of the fires, temperatures rose up to 43 ℃, humidity levels were less than 15%, and winds soared up to 100 km/h. Ash Wednesday resulted in the most loss of life from bushfires until Black Saturday occurred. 75 people died in such a short time. The fires were widespread burning 400,000 hectares in total with half of the land burned in Victoria and the other half in South Australia. There was a total of 180 fires with more than 100 in Victoria.

This source is relevant to our project because it describes one of the fires included in our interactive timeline. The article is credible as it cites government sources. It is important that we understand the fire fully so we can display it correctly to the public.

History of Australian bushfires: Interactive. (2013, December 01). Retrieved from https://www.theguardian.com/news/datablog/interactive/2013/dec/01/history-bushfires-australia-interactive (ref 13)

This source is a timeline that includes basic statistics about some of the major bushfires that occurred in the state of Victoria. At the bottom of the page, there is statistics on how many homes were destroyed during each fire, as well as livestock losses and insurance claims. The timeline also included a picture from every fire.

History Timeline. (2017, November 22). Retrieved from https://www.cfa.vic.gov.au/about/history-timeline (ref 26)

This page on the Country Fire Authority website holds a timeline that provides information on the history of the fire services in the state of Victoria. The timeline includes information on the different fire services department that existed in the state over the years, and how they evolved to what they are today: the Metropolitan Fire Brigade and Country Fire Brigade. The timeline also has information on fire fighting technologies that the brigades used over the years, as well as some dramatic events that the CFA was involved in, such as the collision between two trains in Violet Town.

Hughes, A. R. (n.d.). Black Thursday Bushfires 1851. Retrieved from https://www.portphillippioneersgroup.org.au/pppg5df.htm (ref 13)

This page in the Port Phillip Pioneers Groups website tells the story of the Black Thursday bushfires that occurred in 1851. This article tells the story of the pioneers that settled in Victoria and the hardships they had to go through as the Black Thursday fires swept across their hometowns. The information in the article was taken from the writings of Thomas McCombie, a

novelist and journalist who recorded the scene in Melbourne on that day. McCombie, who lived in Victoria at the time, went from house to house and recorded the damage of the fire and asked families how it affected them. "In the Dandenong area Mr. Henry had his dairy, butter, and other property destroyed; Mr. Maxwell had everything that belonged to him destroyed, his family were in the bush all the following night; they were then taken under the hospitable roof of Mr. Lecky, who escaped with much exertion and perseverance."

Indigenous Fire Management. (n.d.). Retrieved from
        https://www.klc.org.au/indigenous-fire-management/ (ref 12)

This article in the Kimberley Land Council website provides background information on how indigenous fire management is done and the positive outcomes behind it. The article also notes the effects European settlement had on these fire management practices and proceeds to explain that as those practices faded, wildfires in Australia became more destructive.

Jaffe, D. A., & Wigdor, N. L. (2012, May). *Ozone Production from wildfires: A critical*
        review. **Retrieved September 10, 2018, from ScienceDirect.**
        doi:https://doi.org/10.1016/j.atmosenv.2011.11.063 (ref 9)

This informative article discusses chemicals released during a wildfire and how they can compound to form toxic ozone in our environment. Ozone has many health and climate implications and can cause reactions in humans such as irritated lungs, bronchitis, and asthma. In many wildfires, the fuel that is burned emits NMOCs and NOx which will drift away from fires in the plumes of smoke. These chemicals, when combined together and added to other molecules in smoke plumes, can create O3 or ozone. At higher latitudes, where temperatures are cooler, more oxygenated compounds are released by fires and cause more ozone in the atmosphere. In cases where ozone in wildfires was studied, it was found that most of the ozone creation happens far downwind from the blazes, creating health problems for areas far from the fires.

        The information presented in this article can be useful to our IQP group. We want our exhibit to be interesting to all groups of people, but since the museum is in Melbourne, a

populated and urban environment, we want those living in Melbourne to realize fires can affect them as well. People living in cities often think they are out of harm's way from wildfires, however, this information presented in the right manner will educate urban dwellers on why fires can still impact them. This bit of information may be able to spark more awareness about bushfires in Australia if people realize they are at risk of health implications as well.

Knowledge Hub. (n.d.). Bushfire - Black Thursday, 1851. Retrieved from https://knowledge.aidr.org.au/resources/bushfire-black-thursday-1851/ (ref 13)

This page on Knowledge Hub has some statistics on the Black Thursday fires that was essential for our paper background section. While the page does not contain much information, it has many numeral statistics.

Korff, J. (n.d.). Aboriginal fire management. Retrieved from https://www.creativespirits.info/aboriginalculture/land/aboriginal-fire-management#ixzz5VKaY4z7j (ref 12)

This article explains why fire management is essential and how fire management affects the Australian ecosystem. The article explains that today, the approach that is used for fire management and controlled burning is a combination of Western knowledge and traditional knowledge that the Aboriginals possesed. Unfortunately, as Europeans drove the Aboriginals away from their land, those traditional fire management practices faded, and the knowledge of the land is no longer what it used to be. The article claims that there is a need to restore the knowledge the Aboriginals possessed, as their practices were unlike anything that is done today.

Krishnakumar, P., and Joe F. "Why the 2017 Fire Season Has Been One of California's Worst." *Los Angeles Times*, Los Angeles Times, 5 Dec. 2017, www.latimes.com/projects/la-me-california-fire-seasons/.

This article discusses wildfires that happened in California in 2017. It claims that the 2017 fire season was one of the state's worst ones and includes some statistics to prove that

statement. The article also explains that the main reason behind these fires is dry weather and strong winds, which is similar to the conditions in Australia. The article includes several pictures and diagrams that visually present the location of the fires and satellite images of the dry land. Finally, the article provides suggestions related to fire prevention and mitigation.

This article allows us to draw a comparison between Australia and California. It is important to understand some of the similarities and differences between Australia and other places in the world when conducting research on large scale fires.

Lovell, K. (2018, March 23). How the St Patrick's Day fires devastated the south-west. Retrieved from https://www.theherald.com.au/story/5304156/how-the-st-patricks-day-fires-devastated-the-south-west/ (ref 25)

This source describes the Saint Patrick's Day fires which occurred on March 17th, 2018. The article talks about first-hand accounts and provides several statistics. Fires burned throughout the South West region of Victoria. The fires started late on Saturday night around 9 pm and continued for the next 72 hours. The start of the fires was caused by lighting strikes and strong winds up to 104 km/h taking down power lines. Craig Lapsley, the Emergency Management Commissioner for Victoria, told the public that the "weekend would test us". The weather conditions were predicted to be so fire prone that there was a total fire ban on the Saturday of the fires. The destruction from the fires caused 24 homes, 57 sheds, and 10,000 livestock to be lost.

This source is relevant to our project because it describes in detail the Saint Patrick's Day bushfires which is included in our timeline. Background information is needed to successfully understand the fire and provide a clear description to the public in our exhibit.

Lucas, C. (2009, October). On developing a historical fire weather data-set for Australia. https://pdfs.semanticscholar.org/21d7/23a3f047c44fed6b93cb98bb2d8bbdc24a86.pdf (ref 15)

This report discusses the weather conditions during the 1939 Black Friday fires. The report aims to study the climate during that fire in order to understand the relationship between

climate and major bushfires in Australia. By understanding how climate affects the start and scale of bushfires, it is more likely people will be able to manage future fires. This source was used in our paper to note the climate conditions during the Black Friday bushfires.

Murray, R., & White, K. (1995). *State of Fire*. **Melbourne, Victoria: Hargreen Publishing Company. (ref 27)**

This is a book that tells the story of the fire services in the state of Victoria starting with the first recorded devastating fire in 1851(Black Thursday). The book includes the evolution of the fire services, clear records and analysis of volunteer firefighting, the stories of the major bushfires that occurred in the state, and the stories of those who were affected by the fires. The books provides valuable information relating to our exhibit, including the formation of the Bushfire Brigades, the formation of the Country Fire Authority, as well as valuable quotes.

National Museum Australia. (n.d.). Black Saturday bushfires. http://www.nma.gov.au/online_features/defining_moments/featured/black-saturday-bushfires (ref 23, 24)

The purpose of this article is to describe the Black Saturday bushfires. The Black Saturday fires killed 173 people and injured 414. The fire started on February 7th, 2009. 400 individual fires were burning by evening time. There were 47 major fires across Australia all in one day. The first fire started at 11:30 am when strong winds brought down power lines that caused sparking in the Kinglake/Whittlesea area. More than a million wild and domesticated animals were killed in the fires. The fires were caused from a build up hot and dry conditions for two months. 3,500 buildings including more than 2,000 houses were burned. The Supreme Court of Victoria eventually sued SP Ausnet, the company who owned the power lines that caused some of the fires, for AUD 494 million in court and an out of court settlement for AUD 300 million. This article relates to our IQP by describing one of the fires that is featured in our exhibit. The source is also valid as it is from the National Museum of Australia.

Pekarik, A., Button, K., Doering, Z., Sharbaugh, A., Sutton, J. (2002, May). Developing interactive exhibitions at the Smithsonian. Retrieved September 11, 2018, from https://www.si.edu/content/opanda/docs/rpts2002/02.05.interactiveexhibitions.final. pdf (ref 29)

This article has analysis and planning procedures for making an interactive museum exhibit. It includes notes and outcomes from a series of workshop discussions aimed around defining what an interactive exhibit was, what makes them successful, and why they are successful exhibitions when compared to static exhibits. Criterion for what makes an exhibit both interactive and successful was discussed, as well as the aim of what an interactive exhibit should accomplish. The article emphasizes the study of the desired audience, and the objectives it wishes to attain. The main conclusion that the workshop developed was that interactivity should not be limited to discrete interactives, but that the ultimate aim of exhibition makers is to create exhibitions that are holistically interactive, providing a responsive and diverse experience. The exhibition itself should be regarded as a large, multi-part interactive exhibit, and should be analyzed and developed as a whole.

This information was useful in the physical planning and development of our project, including incorporating the interactive timeline. While the scale of the Smithsonian is higher than that of the FSMV, the overall objectives discussed are pertinent to any museum exhibit trying to convey information.

Quang Vu, T., Kellermeier, P. S., Dutton, E. F., & Adams, V. (n.d.). *Museum Space Usage Assessment for the FSMV* **(Rep.). Melbourne Project Center.**

This previous IQP from 2010, conducted at the same museum we worked at, provided extremely valuable information in preparation for our project. This team worked to help the museum volunteers better understand how to use the space they have efficiently. They conducted visitor and worker interviews to understand how everyone feels towards the museum and

specific exhibits within it. The group also created a floor plan that maps out the dimensions of each room and how each room should be used. In creating the floor plan, they studied how visitors move through the museum, noting how frequently each exhibit was viewed and how long each visitor stayed at an exhibit (holding power of the exhibit). They noted that the exhibits that had textual information next to artifacts, visualizations including video and pictures, and interactive qualities held the audience's attention for the longest time.

The group conducted one interview with a museum volunteer who expressed a desire to change the CFA (Country Fire Authority) room as it was decades outdated and should include a Black Saturday exhibit. Since most of the firefighters during the fires we are presenting in our exhibit involved CFA workers, our exhibit will reside in this room when displayed at the museum. From their floor plans, we know the room is 42.9 square meters. This information helped us as we planned our design to fit in this type of room. The group also gave us the research we needed as to what people are looking for when they go to this museum. From a chart in their final report, it is noted that 20% of visitors to this museum are fire service members or are closely connected to them. This helped us orient our exhibit to capture the attention of that audience. Before we began to design our exhibit, we reviewed this IQP project in depth as it gave us a background to start our work on.

RedOrbit, (2012, September 16). How Do Wildfires Impact The Local Economy And Community. Retrieved from https://www.redorbit.com/news/science/1112694583/wildfires-university-of-oregon-social-economic-affects-091612/ (ref 9)

This study conducted in 2008 in the western US aims to determine how different sized communities are affected socially after wildfires. Large wildfires disrupt the lives of people in communities near them, however, employment and wages increase during fires as more services are needed. This often mitigates the short-term disruption wildfires cause. In the USA, when wildfires affect communities, the government provides towns and cities with monetary support to lessen the economic damage. Although employment and wages increase in the aftermath of fires, the seasonal ups and downs in employment cause long-term instability in local labor markets.

This study noted that rural and resource-dependent communities suffered the most significant blows from wildfires and were given the least amount of money from the government.

Although this study was conducted in the United States and not Australia, it still shows the social impacts fires have on local communities regarding employment. In our background section, we discuss how fires can socially affect different communities around Australia. This study gives us critical insights into how fires can raise employment and wages for a short period of time, leaving the long-term employment and wages in an unstable cycle of ups and downs. It was essential for our group to understand how communities could be affected before we interviewed people about fires they endured. We wanted to understand their situation as much as possible before attempting to obtain information from anyone regarding this sensitive topic of wildfire destruction.

Rees, M. (1998, December 11). Concerns raised by deaths of volunteer firefighters. Retrieved from https://www.wsws.org/en/articles/1998/12/fire-d11.html (ref 22)

This source explains what happened on the day of the Linton Bushfire in a broad sense. The article explains the main details of the bushfire such as the day, duration, deaths, and why the fire happened. The article also describes the budget of the CFA and connection with the government.

The source is relevant to our paper as it provides us with information for our interactive timeline. The site also explains how the public reacted to the death of the five firefighters.

Sandri, P., & Girnius, T. (2009, April 16). Fire Down Under: The Black Saturday Fires. Retrieved from https://air-worldwide.com/Publications/AIR-Currents/Fire-Down-Under--The-Black-Saturday-Fires/ (ref 24)

The purpose of this article is to inform readers of the Black Saturday fires and understand how the fires were stopped. The fires started due to a build-up of several factors such as a heat wave, a decade long drought, no rainfall for a month, and temperatures consistently above 38°C. On the day the fires started, the temperature rose above 46°C. More than 1,700 square miles of

land burned. To combat the fires, hundreds of firefighters were called in using fire trucks, helicopters, and fixed-wing aircraft. Firefighters need every resource to take down the fires. The fires were so intense that the fire could only be reduced in size and not be completely extinguished.

The significance of this source in our paper is to demonstrate how the fires were actually combatted and the intensity of the flames.

Simeoni, A. (2018, October 2). Personal interview: (ref 5, 29)

Professor Simeoni, the interim head of Fire Protection Engineering at WPI, provided good data regarding general firefighting practices, as well as information on WPI's Fire Protection Engineering (FPE) major. Students in the FPE program develop safer regulatory policies for building designs, manufacturing processes, first responder operations, and product performance standards. Professor Simeoni has worked as a firefighter both in Europe and North America, with an international perspective being prevalent among professors in FPE, as well as in the FPE Curriculum. Simeoni also discussed how regardless of firefighting technology's advancement, there have always been issues dealing with the size and spread of both urban and rural fires. The majority of fires are still extinguished through the use of water and chemical suppression mixtures, with large-scale fires still ravaging both the natural and city environments. Simeoni also reiterated the fact that both the environment and weather can impact the scale and spread of a wildfire. Even an extremely small human mistake or interaction can cause a cascade of unnatural fires. The largest fires are usually started due to a combination of manmade fires congregating into a devastating mass. When discussing the impacts that these wildfires have had on society, professor Simeoni stressed that many individuals may not be emotionally capable of discussing the events of the more-recent Black Saturday fires. In addition, the psychological damage caused by these fires is equally prevalent in both emergency service workers and ordinary citizens, so sensitive precautions should be taken when interviewing any individual about the traumatic events of a Bushfire.

Stephenson, C. (2010). *A literature review on the economic, social and environmental impacts of severe bushfires in south-eastern Australia*(Rep. No. 87). **Forest Fire Management Victoria. (ref 7)**

This is a report about the effects of severe bushfires on the economy, society, and environment of south-eastern Australia. The 70-page long report discusses many different aspects that relate to the mentioned categories. The report includes information related to economic impacts in the area of tourism, water, agriculture, road networks, and many more. Social impacts include effects on firefighters and communities such as physical health problems, and mental health problems. Environmental impacts include soil, air, flora, and fauna.

The report is valuable to us because Melbourne is located in South Eastern Australia, which is where the location is discussed in the report. It also allows us to better understand the importance of studying bushfires in Australia and how the Australian society is affected by them on a daily basis. The source is credible because it is done by a governmental organization whose main purpose is to study forest fires and manage the fires.

Swaim, C. (2018, January 25). The Art Of Creating A Timeline | History Associates. Retrieved from https://www.historyassociates.com/resources/blog/multidimensional-timelines/

This short article explains the importance of an interactive timeline and several factors that should be considered when a timeline is made. The article emphasizes that interactive timelines are more engaging than exhibits and can often have more educational value due to the way information is put together. A good timeline allows users with different educational levels to learn from it by having the option to go more in depth about a specific subject. To do so, the timeline should allow users to choose how much they would like to learn about different topics.

This is a credible source because it is written by Carlyn Swaim, who is a historian that does research for several museum exhibitions. Both our project and the article relate to timeline creation, so the source is very relevant. Although there are many ways to construct a timeline, it gives us some general information on how to make a timeline well.

Taylor-Coleman, J. (2018, July 25). Wildfires around the world: The photos that explain the flames. Retrieved from https://www.bbc.com/news/world-44943143 (ref 4, 5)

The main focus of this BBC article is to explain the causation and impact of wildfires in a global sense. The article was written in the wake of the Athens fire in Greece that occurred this past July (2018). This allows the points made in the article to be backed up by recently-occurring examples, especially pertaining to urban-environment wildfires. The article also uses quotes from interviews with Environmental Science experts and professors. This includes Thomas Smith, assistant professor in environmental geography at the London School of Economics and Political Science (LSE), as well as forest risk management expert Alexander Held. The interview responses are used in backing-up and reaffirming the points of the article in relation to how bushfires/wildfires are started, spread, and how they can affect an urban environment. While the article is educational in mentioning the causations and effects of wildfires, the focus remains global. It seems more useful as a "general wildfire" source, providing information that is applicable to wildfires in general. In addition to written information, the article includes pictures taken during and after a wildfire/bushfire event, including pictures of textually referenced events.

Teague, B., Mcleod, R., & Pascoe, S. (2010). Final Report (pp. 1-22) (Australia, Parliament of Victoria, Victorian Bushfires Royal Commission). Victoria: Government Printer for the State of Victoria. (ref 16, 24)

This report is the final report of the Royal Commission that was put in place as a consequence of the Black Saturday bushfires. A Royal Commission is announced when there is a need for the public to know the circumstances surrounding a major event. Thus, this commission investigated how the bushfires started and the effects of bushfires. The commission also studied the reasons for the large number of casualties and enacted 67 recommendations related to policy changes. This report is relevant to our research because it is the official governmental report on the Black Saturday bushfires.

Tehan, B. (2016, March 2). The social impact of natural disasters – at what cost? Retrieved

From

https://vcoss.org.au/analysis/the-social-impact-of-natural-disasters-at-what-cost/

(ref 9)

This article is located in the Victorian Council of Social Service (VCSS) website. The VCSS is an organization that provides mental and emotional support to struggling individuals, families, and larger social groups. This article summarizes various studies and reports that discuss the effects of the Black Saturday bushfires. The article presents what the major social impacts of bushfires are on individuals and communities. It also shows the financial costs related to the social issues that arose due to the fires. This article was very relevant to our project because it presents information that helped us understand why wildfires are a societal issue. The article uses various sources and reports, and compares those different studies and reports that otherwise would be difficult to analyze.

The Great Heat. (1898, February 4). *The Argus***, pp. 5-6. Retrieved from**

https://trove.nla.gov.au/newspaper/page/310066 (ref 14)

This primary source newspaper article from February 4, 1898 details the events from Red Tuesday, 3 days prior. The article includes many quotes from civilians and fire service members expressing their concerns that swift wind shifts could stir up another disaster. The locations of the worst fires are documented in this article as well as the death toll. A portion of this article talks about how the telegraph calls for help were not received in time by fire service members and that is the blame for most of the deaths on Red Tuesday.

This source is valuable to our project in a number of ways. First, this primary source is the only first hand account we were able to find relating to the Red Tuesday fires. In the article many of the civilian quotes can be used in our interactive timeline as personal accounts to portray how those affected by the fires were feeling during the disaster. Another important aspect

this newspaper article discusses is the lack of technology of the time and how that greatly affects response time to emergencies. If the telegraph system worked faster, response teams could have slowed the flames and saved lives. Lastly, this article explains the approach firefighters used at the time to slow the flames. It mentions that 130 fire service members set out on Red Tuesday with "beaters" and water to put the flames out. It's important to see how the lack of technology could be the reason Red Tuesday turned into a tragedy.

Tulau, M. J. (2015). Fire and Soils: A review of the potential impacts of different fire regimes on soil erosion and sedimentation, nutrient and carbon cycling, and impacts on water quantity and quality. Office of Environment and Heritage, Sydney. https://www.environment.nsw.gov.au/resources/soils/150623-fire-and-soils.pdf (ref 9)

This article explains how fires affect soil in different intensities of fires. In major bushfires and wildfires, the soil is depleted of organic matter and nutrients such as plant roots, fungi, nitrogen, sulfur, bacteria, phosphorus, and calcium. The organic matter and nutrients combust into the air and leave the soil unable to grow plants. Some factors that determine how long it takes soil to recover include the type of vegetation, the intensity of the fire, and the amount of water taken in. At certain temperatures, different parts of soil combust and evaporate. The first few parts that combust are plant roots, fungi, and bacteria. As the temperature increases, nitrogen, sulfur, and calcium combust. The time it takes soil to recover and gain back all its nutrients can be decades. The significance of this source in our project is to help the readers understand just how destructive bushfires can be to the environment. The destruction of these fires can be long-lasting and take decades for the soil to come back to normal.

Whittaker, J., Haynes, K., Handmer, J., & McLennan, J. (2013, May 31). Community safety during the 2009 Australian Black Saturday bushfires: An analysis of household preparedness and response. http://www.publish.csiro.au/wf/Fulltext/WF12010 (ref 23, 24)

The purpose of this source is to understand the safety of the community of Victoria during the Black Saturday fires. In the days leading up to the fire, John Brumby, the Premier of Victoria, warned the citizens of the potential for bushfires as the weather conditions were predicted to be the worst fire conditions in history. The policy that was used to prepare citizens for the fire was the Stay and Go policy. The policy advised that if you were sure that you could stay and defend your house from the fires then stay, but if you could not, then prepare to leave as soon as possible. The policy caused several issues as a lot of people that stayed ended up dying. Police reports indicated that 113 of the 173 people who died had stayed to protect their house. The importance of this article in our paper is to understand how citizens were prepared for the Black Saturday fires. This source shows that the citizens could have been prepared better.

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