The Pilot Impacts Portal: 
Towards an Emergency Response Planning Tool

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Contents

1 Introduction ................................................................. 1

2 Background .............................................................. 2
  2.1 The Impacts Project ................................................... 2
  2.2 The Impacts Framework .............................................. 3
  2.3 Impacts Project Drivers ............................................. 4

3 Related Work ............................................................ 5
  3.1 Disaster Mapper ...................................................... 6
  3.2 Hazards Monitor ...................................................... 6
  3.3 Harden Up ............................................................ 6
  3.4 Canadian Disaster Database ...................................... 6
  3.5 GDACS ............................................................... 6
  3.6 Global Hazards Atlas ............................................... 7
  3.7 FIRMS ............................................................... 7

4 The Pilot Impacts Portal ................................................. 7
  4.1 The Portal Users ..................................................... 8
  4.2 User Tasks .......................................................... 8
  4.3 Portal Outputs ...................................................... 9
  4.4 Portal Overview .................................................... 9
    4.4.1 The Impacts Framework Explorer ........................... 11
    4.4.2 The Registry Explorer ....................................... 12
    4.4.3 Registration ................................................... 13
    4.4.4 The Map View ............................................... 14
    4.4.5 Other Features ............................................... 17

5 Development Experience ............................................... 17
  5.1 Data Items .......................................................... 18
    5.1.1 Identifying Data Items ..................................... 18
    5.1.2 National Workshop ......................................... 18
    5.1.3 Survey ........................................................ 18
    5.1.4 Data Items Summary ....................................... 19
    5.1.5 Gaps .......................................................... 19
  5.2 Portal Development ................................................ 20
    5.2.1 System Architecture ....................................... 20
    5.2.2 User Acceptance Testing .................................. 21
  5.3 Issues Encountered ................................................. 22
    5.3.1 Google Maps API Terms and Conditions ................... 22
    5.3.2 Google Fusion Tables ...................................... 22
    5.3.3 Locating Events ............................................. 23
    5.3.4 Data Quality ................................................ 23
Abstract

The Pilot Impacts Portal is part of a national initiative to better understand the economic, social and environmental impacts on communities due to fire emergencies and natural disasters. It is a web accessible user interface providing a single point of reference to a collection of national data items describing historical fire emergency and natural disaster (FEND) events and their associated impacts that can be used for evidence based decision making.

The portal is based on the Impacts Framework developed by RMIT and the Bushfire CRC. This framework defines the process used to determine the economic, social and environmental impacts, losses and benefits resulting from a fire emergency or natural disaster. The framework provides a platform to identify those data items required to better understand the impacts due to FEND events. It provides a systematic structure for describing what should be considered before, during and after a fire emergency or natural disaster event.

The Pilot Impacts Portal was developed by the CSIRO as part of a FRNSW managed project and has been operational since 15 June 2012. It is currently undergoing a 12 month trial finishing at the end of June 2013. It is anticipated that members of the Australian emergency services community will find the portal useful and engage with the developers to provide feedback to improve its functionality and data holdings. These are the first steps in building an emergency response planning tool that utilizes evidence of previous events and impacts to help inform future emergency management decisions.

This paper outlines why the portal was built, describes the Impacts Framework and details the portal features including descriptions of the data currently available, who the target users are and how they are expected to use it.

1 Introduction

Natural disasters have increased in severity and frequency in recent years. In 2010, for example, 385 natural disasters killed over 297 thousand people worldwide, impacted 217 million human lives and cost the global economy an estimated US$123.9 billion [25]. Recent Australian examples are: the decade long drought (2003-2012); the 2010-2011 floods in Queensland which affected 70 towns, including Brisbane, and causing infrastructure damage of around A$8 billion\(^1\); Cyclone Yasi which caused around A$800 million in damage\(^2\); and Victoria’s 2009 Black Saturday Bushfires, killing 173 people, impacting 78 towns and having an estimated A$2.9 billion in total losses [29].

In order to effectively prepare and respond to such emergency situations it is critical that emergency managers have relevant and reliable information. This knowledge should include an understanding of the total cost of previous events: the social, economic and environmental costs incurred, the investment in a region on mitigation programs and the community preparedness to counteract and overcome future disasters.

Consequently, emergency and disaster management in Australia is undergoing reform. The Council of Australian Governments’ National Strategy for Disaster Resilience aims to enhance community and organisational capacity to better withstand and recover from emergencies [15]. Australia’s disaster resilience will strengthen when government, business, communities and in-

dividuals collectively adopt risk-based planning and mitigation strategies.

In summary, the issues facing the emergency management sector involve decisions of where to best allocate investment across the PPRR spectrum to increase community safety and reduce the costs and social effects of emergencies and disasters. This will be achieved by improving the quality, availability and management of data and this is the aim of the Pilot Impacts Portal.

The rest of the paper is organised as follows. Section 2 provides background to the Impacts Project including an overview of the Impacts Framework (previous work used as a foundation for the portal) and an outline of the motivation for the project. Section 3 reviews similar activities in Australia and around the world. Then Section 4 describes the features and operation of the Pilot Impacts Portal noting who the expected users are, the tasks they are expected to use it for and the outputs that can be produced. A review of the development experience is presented in Section 5 describing some of the challenges encountered and (mostly) overcome during the course of the project. The report concludes with a discussion of directions for future work.

2 Background

2.1 The Impacts Project

The Australian Natural Disasters Impacts Framework Project\(^3\), referred to from now on as the Impacts Project, is managed by Fire and Rescue New South Wales (FRNSW). It is funded under the Natural Disaster Mitigation Program (NDMP), through the NSW State Emergency Management Committee (SEMC), with 50% contribution from the Commonwealth of Australia and 50% from NSW.

The purpose of the project is to better understand the economic, social and environmental impacts that fire emergencies and natural disasters have on Australian communities to help inform decision making at the policy level. This will enable governments, communities, and Emergency Service Organisations to decide where best to allocate investment across the prevention, preparedness, response and recovery (PPRR) spectrum to increase community safety and reduce the impacts of fire emergencies and natural disasters.

The Impacts Project was designed in two phases delivering, at a high level, the following:

**Phase 1**

1. A Framework for collecting and reporting the impacts and costs of fire emergencies and natural disasters (the Impacts Framework).
2. Identification of existing sources of data to support the Impacts Framework.
3. A directory of questions to measure household preparedness.

**Phase 2**

1. An on-line portal (the Pilot Impacts Portal) to publish the sourced data.
2. An implementation review of the Pilot Impacts Portal at the end of a 12 month trial period.

The first task was completed by RMIT and the Bushfire CRC and is described in Section 2.2

\(^3\)http://www.fire.nsw.gov.au/page.php?id=914
below. The third task was completed by the Australian Bureau of Statistics (ABS). The results for both are available on the FRNSW Impacts Project web site³.

In October 2010, FRNSW sent out a Request for Quotation to complete the remaining tasks. CSIRO were successful in their bid however the project was delayed and did not commence until July 2011. The identification of relevant data items, Phase one task two, and the development of the portal, Phase two task one, were completed over a 12 month period resulting in the deployment of the FEND web site, http://www.fend.org.au/, on 15 June 2012. These activities are the focus of this paper.

The final task listed above will be conducted once the 12 month trial is finished at the end of June 2013.

2.2 The Impacts Framework

The Impacts Framework [24], developed by RMIT and the Bushfire CRC, is based on economic principles and defines the process used to determine the economic, social and environmental impacts, loses and benefits resulting from a fire emergency or natural disaster.

The framework is used as a guide to determine and measure the impacts resulting from an event. It achieves this by identifying the elements contributing to the consequences of an event, defining the relationships between them and by informing the collection of information on a wide range of fire emergencies and natural disasters. It can be used across any temporal or geographic scale, limited or broad. The framework provides an extensive list of possible impacts that the user can select depending on their area of interest and requirements. The framework is not limited to any one phase of the PPRR spectrum and can be used for emergency management, policy-making or other purposes.

An overview of the Impacts Frameworks is depicted in Figure 2.1, taken from [24]. This figure can be interpreted from top to bottom using the text below each yellow box to explain the process of identifying an impact. Doing so reveals: an event comprises a number of event characteristics which have an effect on an object possibly causing harm which can lead to a range of observed and (in many cases) measurable impacts, which can be categorised as being economic, social or environmental. Also, the prevention and preparedness aspects of emergency management practices are shown on the left while the role of response and recovery are on the right.

In summary, Figure 2.1 provides a top down approach to describing how to arrive at an impact starting from an event, noting the possible event characteristics, how they interact with an object in the real world, causing harm which results in a specific impact.

The Impacts Framework is a Microsoft Excel spreadsheet [23] with supporting documentation [24]. It is a large and complex source of information that is expected to be a useful resource for members of the emergency management community. There are almost 3,000 direct impacts defined (the immediate consequences resulting from direct contact with the event) in the spreadsheet and a further almost 30,000 indirect impacts (impacts that arise as a further consequence of a previous impact).

The framework was the initial reference used by CSIRO to determine the data items required by the portal. In this regard, the Impacts Framework can be considered metadata describing the data items or a thesaurus categorising the data items to be included in the repository (data warehouse) of the portal.
2.3 Impacts Project Drivers

The motivation for the project can be summarised by the following question:

Do we know where to best allocate investment across the PPRR spectrum to increase community safety and reduce the costs and social effects of emergencies and disasters?

Various Council of Australian Governments (COAG) reviews have highlighted the need for more comprehensive data on the full costs of natural disasters and emergencies and emergency risk management services. This will enable governments and communities to undertake cost benefit assessments and identify the most cost effective mix of risk based emergency management investment in PPRR interventions across all hazards.

At present, collating all the available data necessary to identify the total costs of emergency risk management within a community is extremely difficult and beyond the capacity of most stakeholders. Some of the key data required is currently not collected or inaccessible. Case
studies tend to focus on one disaster or type of emergency and hence do not provide an ‘all hazards’ view of the costs and benefits of emergency risk management investment.

The COAG Report Natural Disasters in Australia [1] lists 12 recommendations for all levels of government to reform Australia’s natural disaster management (page 14). The first two are:

1. develop and implement a five-year national program of systematic and rigorous disaster risk assessments
2. establish a nationally consistent system of data collection, research and analysis to ensure a sound knowledge base on natural disasters and disaster mitigation

The second recommendation above was the original motivation for the Impacts Project. This is the overriding requirement to be fulfilled.

There have also been other significant reports and findings recommending a more unified and comprehensive approach to emergency management and reducing risks. For example:

- The report of the ANZLIC Counter Terrorism Project (2003) (note that the report Using Australia’s Spatial Information Infrastructure for Counter-Terrorism is confidential).
- The COAG report National Inquiry on Bushfire Mitigation and Management (2004) [5].
- The recent formation of the National Information Management Advisory Group (NIMAG).
- The international emergency management trend towards interoperability (shared data systems and access).
- The Emergency Management Information Development Plan (2006) [7].

These groups and their reports all advocate, amongst other findings, the need for improved access to relevant information for the purposes of emergency planning and response. This can be summarised as:

Delivering the right information to the right people in the right format in the right place at the right time.

3 Related Work

The need for timely information for the purposes of disaster and emergency management and for historical disaster event information is recognised both domestically and internationally. A few examples are noted below.
3.1 Disaster Mapper

Disaster Mapper\(^4\) is an interactive map-based web application for researching historical disasters. Developed by the Australian Government Attorney-General’s Department (AGD) as a resource for schools, it shows over 50 disaster events that have occurred since the early 1900s. Each event is supported by statistics, images, videos and text. Events are searchable by location, time or type of disaster.

3.2 Hazards Monitor

The Hazards Monitor web application\(^5\) developed by aus-emaps.com displays current information published by international agencies who monitor emergencies, weather (Australia only) and earthquakes. There are currently four maps available: Emergency Incidents, Earthquakes, Bushfires and Weather. Each map has several layers of data which can be turned on or off.

3.3 Harden Up

Harden Up - Protecting Queensland\(^6\) has been developed by the environment group Green Cross Australia with funding from the Queensland Department of Community Safety. The aim is to help the citizens of Queensland understand the history of severe weather in their local area and to help them prepare for future events. The Harden Up database contains information on 3,000 historical weather events. These events are searchable using a map-based interface.

3.4 Canadian Disaster Database

The Canadian Disaster Database\(^7\), developed by Public Safety Canada, contains information on over 900 disasters that have directly impacted Canadians at home or abroad. The database is searchable via a combination of map and web form interfaces.

3.5 GDACS

The Global Disaster Alert and Coordination System (GDACS)\(^8\) collects near real-time hazard information to provide global multihazard disaster alerting and impact estimations for earthquakes, tsunamis, tropical cyclones, floods and volcanoes. This service is managed by the European Commission Joint Research Centre (JRC). The GDACS web site lists detailed information for current events and also maintains a searchable archive of historical events. Selected events are located on a map. GDACS have a mobile app, iGDACS available on iTunes, that allows you to receive GDACS alerts and key statistics on your iPhone or iPad. This app allows users to provide feedback on GDACS events. GDACS also provides a real-time coordination platform ‘VirtualOSOCC’ which is used by 14,000 disaster managers worldwide for information exchange and coordination in the first disaster phase. The JRC are currently exploring the use of social media as an additional data source for disaster response [30].

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\(^4\)http://disastermapper.ema.edu.au
\(^5\)http://www.aus-emaps.com/fires.php
\(^6\)http://hardenup.org/
\(^7\)http://www.publicsafety.gc.ca/prg/em/cdd/index-eng.aspx
\(^8\)http://www.gdacs.org/
3.6 Global Hazards Atlas

The Pacific Disaster Centre’s Global Hazards Atlas is a map-based web application for displaying the current active hazards worldwide. It can also display historical event data as well as a selection of baseline data.

3.7 FIRMS

The Fire Information for Resource Management System (FIRMS) provides a web mapping interface displaying near real-time hot spot (fire) information obtained from satellites. Monthly burnt areas are also calculated and an email service is available for subscribers to receive alerts. Similar Australian systems also exist, the Hazards Monitor mentioned above and the Sentinel Hotspots from Geoscience Australia (GA).

4 The Pilot Impacts Portal

The Pilot Impacts Portal is based on the Impacts Framework. The framework provides a platform to identify the data items required to better understand the impacts due to FEND events and provides a systematic structure for describing what should be considered before, during and after a fire emergency or natural disaster event.

An external view of the role of the portal in terms of the entities who interact with it and the information exchanged (inputs and outputs) is shown in Figure 4.1. The data is supplied by a data custodian who initially provides new data to be included in the portal by the portal administrator. This data may periodically be updated by the administrator using data supplied from the custodian.

Figure 4.1: Pilot Impacts Portal Overview

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9 http://www.pdc.org/atlas
10 http://earthdata.nasa.gov/data/near-real-time-data/firms
The portal user uses a web browser as the client interface to access the portal. These users may obtain data extracts of information contained in the portal or produce a report as a data summary. The administrator is responsible for user management, monitoring the system performance and coordinating the inclusion and updating of the data items.

The roles of the administrator and custodians are outside the scope of this report. The following sections describe who the users are expected to be, the tasks they are anticipated to use the portal for, the outputs available to them and provides an overview of the main portal features.

4.1 The Portal Users

The portal user depicted in Figure 4.1 represents a large collection of possible users ranging from emergency management personnel (people associated with fire fighters, ambulance officers, police, rescue personnel, SES, and so on), government (federal, state and local agencies), and community groups. These users will each have a particular objective when using the portal broadly defined as supporting evidence based decision making on where best to allocate investment across the PPRR spectrum to increase community safety and reduce the costs and social effects of emergencies and disasters.

The portal users are characterised as belonging to one of the following:

- A policy maker involved in the emergency risk management sector, health sector, or climate change.
- Program and policy evaluators.
- Crisis management teams, operational front-line staff and discovery teams.
- Building science professionals, researchers and standards and product developers.
- Governments (including local government councils) and regulators.
- Insurance companies and loss adjusters.

4.2 User Tasks

The Pilot Impacts Portal integrates data managed by various Government agencies using a Google Map interface that allows users to access disaster event information by geographic region. The interface provides various access paths to this information allowing the portal user to:

1. Explore the Impacts Framework.
   The user interface supports exploration of all aspects of the Impacts Framework.

2. Identify data items relevant to a specific event.
   Explore the meta data describing the data items.

3. Discover data items by geographical region and time.
   Navigate the map of Australia using pan and zoom functions, specify bounds on the time period (a date range) to explore and so on.

4. Discover data items by disaster category.

The portal users will interact with the system through three distinct scenarios:
1. Pre-event
   Risk analysis, planning and evaluation of mitigation options before an event

2. During an event
   During or immediately after an event to provide situational reports

3. Post-event
   After the event to assess impacts and inform future action across the PPRR spectrum

Specific examples of how the portal may be used are: conducting state wide assessments; prioritising grant money for recovery processes; identifying vulnerable communities; informing operational management and resource allocation during large scale events; and identifying damage and losses to develop and prioritise prevention and preparedness programs.

4.3 Portal Outputs

Recognized users, explained in Section 4.4.3, can generate reports from the web interface summarising the information they have obtained from the portal and export data extracts (subsets) of the available data items.

Reports are PDF documents that contain the following information for a selected region$^{12}$:

- **Report Summary**
  The details of the user who created the report, when it was created, the LGA or SLA region selected and the date range for events (when selected).

- **Map Overview**
  A map showing the LGA or SLA chosen as the selected region.

- **ABS 2010 Population Estimates**
  The population by age groups [16] for the selected region.

- **AGD Disasters Events (optional)**
  A list of the events from the AGD Disaster Database [17] for the specified date range.

- **NEXIS Building Information (optional)**
  The residential, commercial and industrial building information [19] for the selected region.

- **Acknowledgements**
  A list of the data custodians and URL references whose data has been included in the generated report.

The information in the report is expected to provide evidence for the user to support their investigation.

Another output available for a user is a *data extract*. This is a CSV file containing a subset of the data items available in the portal for a selected region. This feature allows a user to further explore relevant data items using tools available to them.

4.4 Portal Overview

The Pilot Impacts Portal is a web accessible user interface to a collection of data items relating to the Impacts Framework. It is a platform to show the benefits of having a single point of access to a wide collection of data items that can be used for evidence based decision making. The

$^{12}$An ABS Local Government Area (LGA) or Statistical Local Area (SLA).
aim is to foster an emergency management user community focused on a national resource (the portal).

It is also useful to define what the portal is not. The portal does not provide the facility to conduct modelling or forecasting. It was not designed to analyze the total impacts of fire emergencies and natural disasters on a community; nor was not designed to be used for monitoring the current situation during a disaster event. All data available in the portal is managed locally: for example, there are (as yet) no live data feeds or data obtained from web services.

The portal collates data from various sources to report against the Impacts Framework including:

- **Baseline data**
  The context in which an event occurs.

- **Historical Event data**
  Information about specific fire emergency or natural disaster events.

- **Historical Impacts data**
  Details the measured impacts resulting from a specific event as either direct or indirect impacts.

- **Mitigation and Recovery**
  The history of funds spent and actions performed in a region for PPRR.

The portal is available at: [http://www.fend.org.au/](http://www.fend.org.au/). The key user interface elements are noted in Figure 4.2 where the Map View is shown.

![Portal User Interface elements](image)

**Figure 4.2: Portal User Interface elements**

The highlighted elements in Figure 4.2 are described below which introduces terminology used
throughout the portal:

- **Navigation Bar**
  This contains a number of interrelated components identified by their labels: **Home, Framework, Registry, Map, Help, Acknowledgements** and **Contact Us**. The different tabs are mostly referred to as pages, for example the **home page**, the **help page**, however, the following are referred to differently since they provide special features specific to the portal:
  - **Framework Explorer**
    The Framework Tab on the Navigation Bar.
  - **Registry Explorer**
    The Registry Tab on the Navigation Bar.
  - **Map View**
    The Map Tab on the Navigation Bar.

These features are discussed in more detail below.

- **Accordion Tabs**
  These are similar to regular tabs except they are vertical instead of horizontal. An accordion tab is only used as part of the Map View and consists of five tabs: **Layers, Locations, Building Information, Historical Events** and **Reports**. The reports tab is only available for ‘recognized users’, explained in Section 4.4.3.

- **Google Map**
  The Map View contains a Google Map which provides street map, terrain and satellite imagery backdrops for Australia. The map can be overlaid with further geographic data managed using the Accordion Tabs. Figure 4.3 provides an example of historical fires in Tasmania with the Local Government Areas (LGAs) layer displayed and the details of a specific fire incident shown in a popup window.

- **Google Map Controls**
  The Google Map can be panned and zoomed in and out using the mouse or by the built in Google Map controls highlighted in Figure 4.2. These controls will be familiar to users of Google Maps.\(^\text{13}\)

The portal was developed with the aim of being self explanatory in its operation. There is a detailed User’s Guide\(^\text{14}\) that is an introductory manual for new users and provides a reference document for using the portal.

The following sections describe the key elements of the Pilot Impacts Portal in more detail.

### 4.4.1 The Impacts Framework Explorer

The portal user is able to explore the content of the Impacts Framework by navigating it in terms of the disaster category (bushfire, cyclone, flood, and so on), the event characteristics, the type of objects impacted by an event, the harm that results, and the economic, social and environmental impacts themselves.

An example of finding the impacts in the framework that result from a bushfire that destroys...

\(^{13}\)http://support.google.com/maps/bin/answer.py?hl=en&topic=1687350&answer=144350.

public infrastructure is shown in Figure 4.4. In this example the user has navigated to that part of the Impacts Framework associated with the destruction of public infrastructure caused by a bushfire. Note that the ‘Event Characteristic’ and ‘Object’ are set at ‘(all)’ meaning that all of these options are chosen. This can be refined to reduce the amount of information displayed.

Figure 4.4 shows the results of this query as provided by the Impacts Framework as a collection of direct impacts: the immediate consequences resulting from direct contact with the event. A more targeted query is shown in Figure 4.5 where the ‘Event Characteristic’ is set to ‘Flame’ and the ‘Object’ is set as ‘Roads’. The result is a single direct impact: ‘The Destruction of Roads’, which has been expanded to show all the consequential impacts that can also result. These are termed indirect impacts. Note that an indirect impact may cause another subsequent indirect impact up to a ‘depth’ of five.

The ‘Tree View’ shown above is one option for displaying the results when exploring the Impacts Framework content. A ‘Table View’ is also available that corresponds to the way the content of the Impacts Framework is presented in the original Excel spreadsheet. A summary of the categorization of the impacts, regardless of relationships (being direct or indirect), are available in the ‘Economic’, ‘Social’ and ‘Environmental’ tabs in the results section.

4.4.2 The Registry Explorer

The registry is where the source data items are managed for use in the portal. Each data item is classified as belonging to one of the data item categories defined in Section 4.4: baseline, events, impacts and mitigation and recovery. A description of the data items managed in the portal can be found using the Registry Explorer. The metadata of the data items can be explored.
by choosing one of the data item categories and then selecting either a specific event or the objects of interest to find what data items match the selection.

A full listing describing all data items available in the portal is also available\(^\text{15}\).

### 4.4.3 Registration

Access to the Map View component of the Portal is restricted to registered users. Registration is available to anyone with an email account. Users ‘self register’ which means they are responsible for creating their own user account.

The registration process consists of the following steps:

1. Complete the registration web form\(^\text{16}\).

2. An email is sent to the user containing a user specific ‘activation’ URL.

3. The activation URL must be opened in a browser to enable the user’s account.

The user account cannot be used until it has been activated.

Only users with an email account from a recognised organisation are allowed to produce reports

\(^{15}\)http://www.fend.org.au/portal/registry

\(^{16}\)https://www.fend.org.au/pipadmin/admin_create_user.jsp
and extract data items from the portal. These recognised organisations\textsuperscript{17} are those considered \textit{authorised} to generate reports and extract data. This list includes, for example, \url{gov.au}, \url{csiro.au} and \url{edu.au}. Anyone who self registers with an email address ending in one of these examples is considered a \textit{recognized user}.

\subsection*{4.4.4 The Map View}

Examples of the Map View can be seen in Figures 4.2 and 4.3 showing a Google Map as the main feature. The Accordion Tabs on the right of the map includes the following display elements:

\begin{itemize}
  \item \textbf{Layers}
    Layers are geographic information that can be overlaid on the Google Map to provide further context in which the fire emergency and natural disaster event occurs. These are region boundaries and natural environmental geographic features. So far there are ABS boundary layers and waterways that can be displayed as layers over the Google map. ABS population statistics are also available for these layers, as shown in Figure 4.3.
  
  \item \textbf{Locations}
    The Locations Accordion Tab provides a mechanism to navigate the Map View as shown in Figure 4.6. Four options are available:
\end{itemize}

\textsuperscript{17}https://www.fend.org.au/pipadmin/admin_orgs.jsp
1. State
A state or territory can be chosen from the list provided. The Map View will be updated to display the chosen region. After choosing a state or territory further navigation options may be present depending on the option chosen in the ABS ASGC Regions in the LayersAccordion Tab.

2. LGA or SLA
The name of a known LGA or SLA region can be entered directly. After the first three characters are typed, the possible matches are displayed and can be selected. Again, the Map View will be updated to display the chosen region.

3. Find Location
A named location can be typed and the ‘Search’ button will update the Map View to display the chosen location with a map marker. The location entered may be as detailed as a street address or may simply be a suburb, town or city.

4. Reset Zoom
This button returns the Map View to the whole of Australia, the initial starting display as shown in Figure 4.2.

- Building Information
NEXIS [19] data is available from the Building InformationAccordion Tab. There are three
categories of building information: Residential, Commercial and Industrial as shown in Figure 4.7. In order to display building information, a selected region must be chosen: an ABS ASGC LGA or SLA region. When a selected region is active, the region boundary is highlighted in yellow as shown in Figure 4.7, and it is also noted on the ‘Layers’ Accordion Tab. This can be seen in Figure 4.3, although in this case no region has been selected, indicated by the text None selected.

Figure 4.7: Building Information Accordion Tab

• Historical Events
The Historical Events Accordion Tab, Figure 4.8, allows the various fire emergency and natural disaster events to be explored and the associated impacts to be obtained. A date range can be entered and various categories of natural disasters chosen. When the ‘Show Events’ button is chosen, the Map View is updated with icons and overlays showing the events matching the chosen options. The events that can be chosen are organised by their data source. The portal has various event information that is depicted differently depending on the event type: cyclone tracks (using red lines), earthquakes (semi-transparent maroon dots of varying sizes with larger dots indicating stronger earthquakes), flood regions (semi-transparent blue regions) and fire locations (using a flame icon). Information from the AGD Disasters Database [17] is shown using icons. These different display features are shown alongside their check boxes, refer to Figure 4.8.
Further information about a specific event depicted in the portal can be obtained by clicking on the event. This displays a pop-up as shown in Figure 4.3.

- Reports
  Reports and data extracts have been discussed in Section 4.3.

4.4.5 Other Features

There are further features available in the portal, detailed in the User Guide\(^4\). For example, users can provide feedback to the portal developers through a web form; and portal activity is logged; and the services available are monitored by software that informs (by email) the administrator when something goes wrong.

5 Development Experience

The activities of identifying and obtaining the data items, developing the portal software, the issues encountered and an overview of the current portal hosting and evaluation period are described below.
5.1 Data Items

The process to identify and obtain the data items was:

1. Investigate and understand the Impacts Framework.
2. Determine the data required.
3. Establish who has the data.
4. Define the criteria to evaluate the suitability of the data for use in the online portal.
5. Contact the data custodians:
   - Communicate information about the Impacts Project.
   - Survey the custodians to identify existing relevant data items.
   - Collect responses.
   - Identify relevant data items using the above criteria (step 4).
6. Obtain data items.
7. Document the data found.

An overview of these activities is presented below, summarised from the project report [27].

5.1.1 Identifying Data Items

The task of identifying and obtaining the data items was performed by contacting relevant government agencies and other institutions by phone and email, having face to face meetings and by visiting relevant web sites. A total of 39 agencies were contacted during the course of the project. This was not expected to be an exhaustive consultation of all the relevant government agencies, private companies, universities and research institutions. It was aimed to target a representative cross section of the relevant data custodians.

5.1.2 National Workshop

A selection of prospective data custodians and potential users were invited to a national workshop held in mid October 2011 to discuss the project aims and objectives. During the workshop, a preliminary list of relevant data items was identified including a contact person when known. A data items survey was sent to these contacts with the aim of establishing what data currently exists, who maintains it, the format it is in, if it is available for use in the portal and the terms and conditions of using it.

5.1.3 Survey

After the workshop, 11 agencies were sent surveys in mid December 2011 and by the end of March 2012 five were completed and returned. Of the five, three indicated they had no relevant data items (AGD Emergency Management Capability Development Branch, Bushfire CRC and Department of Climate Change and Energy Efficiency), one had data but indicated that it would not be readily available for use in the portal (AGD National Disaster Recovery Programs Branch) while one agency had data and provided it to CSIRO (GA National Exposure Information System).

Note that not all potential data custodians have been contacted. Although the workshop identified a preliminary list of custodians, the workshop participants did not include all possible custodians. A representative cross section of the relevant data items custodians has been contacted. This
will be an ongoing activity for the duration of the project and will continue throughout the hosting period. It is expected that further data items will be identified by users of the portal.

### 5.1.4 Data Items Summary

A summary of the data items available in the portal is shown in Table 5.1. The custodian the data item came from is noted along with its category: one of Framework (being the Impacts Framework itself); Event data; Impacts data; Mitigation and Recovery; and Baseline. This information can also be seen in the registry listing\(^{15}\).

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Custodian</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts Framework</td>
<td>FRNSW</td>
<td>Framework</td>
</tr>
<tr>
<td>ASGC LGA 2010 [12]</td>
<td>ABS</td>
<td>Baseline</td>
</tr>
<tr>
<td>ASGC POA 2010 [9]</td>
<td>ABS</td>
<td>Baseline</td>
</tr>
<tr>
<td>ASGC SLA 2010 [12]</td>
<td>ABS</td>
<td>Baseline</td>
</tr>
<tr>
<td>BCP 2006 [10]</td>
<td>ABS</td>
<td>Baseline</td>
</tr>
<tr>
<td>Populations 2010 [16]</td>
<td>ABS</td>
<td>Baseline</td>
</tr>
<tr>
<td>National AIRS DB [18]</td>
<td>AFAC</td>
<td>Event/Impacts</td>
</tr>
<tr>
<td>Disasters Database [17]</td>
<td>AGD</td>
<td>Event/Impacts</td>
</tr>
<tr>
<td>AHGF [20]</td>
<td>BOM</td>
<td>Baseline</td>
</tr>
<tr>
<td>Tropical Cyclones [21]</td>
<td>BOM</td>
<td>Event</td>
</tr>
<tr>
<td>DFO [22]</td>
<td>Colorado Uni</td>
<td>Event/Impacts</td>
</tr>
<tr>
<td>Earthquakes DB [14]</td>
<td>GA</td>
<td>Event</td>
</tr>
<tr>
<td>GEODATA Topo 250K [8]</td>
<td>GA</td>
<td>Baseline</td>
</tr>
<tr>
<td>NEXIS [19]</td>
<td>GA</td>
<td>Baseline</td>
</tr>
</tbody>
</table>

Note that a mix (by years) of ABS ASGC boundaries were used due to the availability of associated population demographics for these regions.

### 5.1.5 Gaps

Comparing the list of data items currently available in the portal against the content of the Impacts Framework identifies various gaps in the data obtained:

- There are no event data items describing meteorite strikes, storm surges, or Tsunamis.
- The impacts data items do not reference 35 of the 51 objects described by the Impacts Framework.
- No Mitigation and Recovery data items have as yet been identified for use in the portal.
- There are no baseline data items identified for 25 of the 51 objects described by the Impacts Framework.

The Impacts Framework contains specific details of the impacts that may occur from a fire emergency or natural disaster event. While this is useful to help understand the full economic, social, and environmental impacts, loses and benefits resulting from a natural disaster or fire emergency, finding existing data items that match the level of detail that exists in the framework has been a challenge.

The Pilot Impacts Portal | 19
5.2 Portal Development

The process undertaken to develop the portal was based on a mix of ‘traditional’ and agile approaches to software development. Specifically: user stories were defined describing how the proposed portal system was anticipated to be used; prototypes iteratively developed to demonstrate features and concepts to the client; the prototypes refined, as four major milestones, to produce the final system; and user acceptance testing performed by target users to ensure the requirements were met.

An overview of the system architecture is presented below along with a summary of the user acceptance testing.

5.2.1 System Architecture

Figure 5.1 shows a high level overview of the Pilot Impacts Portal components highlighting the technologies used, the categories of data items available and some of the tasks that can be achieved. The various components are briefly described below, summarised from the Administrator’s Guide [28].

- **Browser**
  The user accesses the portal using a standard web browser. The portal has been tested with Internet Explorer, Firefox, Google Chrome and Apple’s Safari. These Browsers make use of client side technologies of: JavaScript, AJAX and jQuery. The browser accesses the portal's web server via a reverse proxy (described below) and also makes use of the Google Map API and Google Fusion Tables. The user can produce PDF reports and extract information from the portal as CSV and HTML.

- **Tomcat Web Server**
The portal is deployed as three web applications (web apps) on the Tomcat Web Server:

- **Portal**
  The various portal user interface elements: Framework Explorer, Registry Explorer, Map View, online help, feedback form, user activity logging, report generator and data extracts. There are various supporting Tomcat servlets included: data access servlets for each data item; a registry servlet; framework servlet. The technologies used are Java, JSP, JSON, HTML and JDBC.

- **Admin**
  The administration web app provides functions for users to self register and for the portal administrator to manage users. The details of registered users are maintained in an Oracle database. There is a web page (only accessible by the portal administrator) to list registered users and to perform tasks associated with user management (suspend/resume, modify, reset password, resend an activation email, extend expiry date). The technologies used are Java, JavaMail, HTML and JDBC.

- **Monitor**
  The monitor web application is used to monitor the current portal status and user activity.

The FEND web site is deployed on a virtual machine within the CSIRO network and external access is directed through a reverse proxy. This is an added security measure; the reverse proxy is a tightly controlled machine which only allows Internet requests to the FEND site to be redirected to the web server on the internal CSIRO virtual machine.

- **Monitor Program**
  The monitor program periodically (currently every 5 minutes) sends a sequence of test queries to the portal web app to test it is operating correctly. The results of the test queries are compared with the expected results and a summary is recorded in the database. When an error occurs, an email is sent to the portal administrator.

- **Oracle DB**
  The Oracle database is used to store the data items for use in the portal as well as details about registered users, the data items metadata (the registry), user feedback, the monitor results and a log of user activity.

- **Google**
  The Map View makes use of the Google Maps API which provides street map, terrain and satellite imagery backdrops for Australia. Google Fusion Tables18 allow map layers to be overlaid on a Google Map. This has been used for the ABS ASGC regions of LGA, SLA and CCD.

### 5.2.2 User Acceptance Testing

User Acceptance Testing (UAT) is a process performed by users to determine if a system functions correctly according to the system specification. The process is guided by a series of test scripts which are each aimed at verifying that a particular business function is achieved by the system being tested. The test scripts are established in reference to the system requirements.

The UAT process is performed at the end of system development. It is the final task undertaken.

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to ensure the delivered system meets the user’s expectations and correctly achieves the stated business functions defined in the requirements. Successful completion of the UAT is necessary for the client to accept the new system.

The user stories captured at the start of the project and refined at the national workshop were used to inform the system requirements. This was recorded in a Requirements Specification [26]. At the end of the portal development these requirements were used to develop eight test scripts: detailed instructions to operate the portal including the outcomes expected.

Three groups of users, termed the ‘early adopters’, volunteered to participate in the UAT: WA Fire and Emergency Services Authority, Qld Department of Community Safety, and FRNSW. Between them they provided over 50 comments which were each addressed prior to making the final system available to the general public. This process was valuable for the developers as it provided feedback on ways to improve the portal and the documentation that supports it.

5.3 Issues Encountered

There have been a number of issues and obstacles encountered as outlined below.

5.3.1 Google Maps API Terms and Conditions

The terms and conditions of using the Google Maps API states that it cannot be used when access is restricted to a ‘closed community’[19]. Access to the portal was originally planned to be restricted to users from ‘recognised organisations’, as defined in Section 4.4.3. This would have violated these terms and conditions.

Instead, access to the portal is available to anyone, with restrictions on the (non map) functionality available to users not affiliated with a ‘recognised organisation’: these users cannot extract data or produce reports. The aim is to encourage users to register with their work email so the activity on the portal can be associated to particular organisations. This will allow the developers to gain an insight as to how the portal is being used by different organisations.

5.3.2 Google Fusion Tables

There are some constraints in using Google Fusion Tables[18]: the data loaded must be in Keyhole Markup Language (KML) format; the KML data must be less than one million characters in length; each table has a 100Mb table limit; and MultiGeometry KML elements can only have a maximum of 10 polygons.

The ABS ASGC layers of LGA, SLA and CCD are loaded into Google Fusion Tables so they can be displayed over the Google Map in the portal's Map View. This data is available as ESRI Shapefiles from the ABS web site and had to be converted into KML meeting the restrictions noted above. This was done using Oracle Spatial by first converting the Shapefiles into Oracle's spatial format (using the shp2sdo tool); loading into Oracle (sqlldr); fix the geometries that are not valid (required by Oracle in order to do any further spatial processing); simplify the geometries (use fewer points to describe each polygon); convert the multi-polygons into single polygons (‘denormalize’ the multi-polygons); and convert to KML. Then the data can be loaded into Google Fusion Tables and are available as geographic layers by the portal.

These layers are tiled into sections by Google and the tiles sent to the client browser as required. On occasion, the map tiles are not always available resulting in a map with missing tiles and the

[19] https://developers.google.com/maps/terms#section_9_1

22 | The Pilot Impacts Portal
words *Data may still be loading* displayed instead. This problem occurred semi-frequently in the early development phase and was resolved by a JavaScript HTML page that periodically (once an hour, randomly timed) loads the map tiles. We believe this keeps the tiles in a ‘cache’ at Google.

### 5.3.3 Locating Events

The data describing historical disaster events has varying levels of accuracy. Some data items include specific geographic coordinates, such as earthquakes and cyclone tracks, whereas others are described with a general location. For example, the AGD Disasters Database sometimes only includes a very rough idea of where the event was geographically located. Each event is assigned to one or more map regions\(^{20}\) defining a grid for Australia. These regions are used to place icons on the portal’s Map View corresponding to the events occurring in these regions.

Locating events in this way is only approximate and has the added problem that multiple events in the same region are given the same location resulting in icons being stacked on top of each other. This was resolved by including a small random offset in these cases to disperse the icons so they can be distinguished. This process is known as *cartographic generalization* and is a standard practice when rendering information on a map.

A similar issue was that some locations are defined using place names. The Yahoo GeoPlanet web service\(^ {21}\) is used to find a suitable place match. Note that the task of locating an event is performed during data loading to assign permanent geographic coordinates. The results were reviewed by a person and are subsequently used when displaying the events in the portal.

### 5.3.4 Data Quality

There were data quality issues with some of the data items obtained which were manually fixed. The Dartmouth Flood Observatory \[22\] is a global archive of large flood events available as an ESRI Shapefile with further data available as a CSV. When displaying the flood extents as polygons, some of them did not correspond to their descriptive text. For example, there were flood extents in Western Australia that described as occurring in New South Wales and there were floods in South East Asia that were noted as occurring in Australia. The problem seemed to be a ‘shift’ of one row for the data in the Shapefile and corresponding CSV. This problem was manually fixed and the data custodians notified: a final resolution is forthcoming.

Also, the content of the AGD Disaster’s Database \[17\] is currently being revised. Over the course of the Impacts Project the publicly available database has been downloaded on four occasions and each time the amount of information available has decreased as noted in Table 5.2. It is assumed that the quality of the information being made available is increasing with each release.

<table>
<thead>
<tr>
<th>Date Obtained</th>
<th># Events</th>
<th># Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 Oct 2011</td>
<td>790</td>
<td>232</td>
</tr>
<tr>
<td>1 Feb 2012</td>
<td>517</td>
<td>180</td>
</tr>
<tr>
<td>7 May 2012</td>
<td>244</td>
<td>102</td>
</tr>
<tr>
<td>22 Jun 2012</td>
<td>240</td>
<td>86</td>
</tr>
</tbody>
</table>


5.3.5 The Impacts Framework Model

Further work needs to be undertaken to better understand the model underlying the Impacts Framework. This will allow: improved linkage of data items to the Impacts Framework content; improved understanding of indirect impacts; incorporating methods to measure impacts; and extensions to the framework to be included.

5.3.6 Data Availability

Some data custodians have data, but it is not readily available for use in the portal due to cost, licensing constraints, availability, or sensitivity of the data. For example, the Public Sector Mapping Agency data costs approximately A$50,000 per year to licence and data from Risk Frontiers could not be made publicly available.

5.3.7 Existing Data Repositories

There are data items relating to the Impacts Framework which exists as collections of reports describing, for example, specific natural disaster events, post event surveys, and risk studies. Some of these reports have been collected when they are available from web sites for use in the portal. However in many cases these reports exist, but are not available for the following various reasons: the reports are not managed as a single resource; the report contents are often an aggregation of data from other sources (and these original sources should be identified for use in the portal); the data items are distributed throughout the organisation; and no single person knows where they are located.

5.3.8 Data Coverage

As noted above in Section 5.1.5, there are gaps in the collected data items in terms of the content of the Impacts Framework. Importantly, there have been no Mitigation and Recovery data items identified for use in the portal. While such data does exist, in discussions with some agencies the availability of this data has been an issue. Although they have data, it is not readily accessible since it only exists in individual reports distributed throughout the organisation. Accessing these reports is problematic for the same reasons outlined above.

5.4 Evaluation Period

The portal went ‘live’ on 15 June 2012 and is currently undergoing a 12 month trial finishing at the end of June 2013. Members of the Australian emergency services community were notified of the release and in the first two weeks over 30 users registered. There are currently around 70 registered users.

During the hosting period CSIRO will provide administrative support, monitor usage, promote the portal and contribute to the evaluation report. For the portal to be a success it needs to be used and extended as required to meet the needs of those for whom the portal was built.

6 Future Work

The original aims of the Impacts Project were to provide Emergency Services Organisations better information about fire emergency and natural disaster events so they can improve their decision making around PPRR investments in terms of community safety and reducing the impacts of future events. The Pilot Impacts Portal supports these aims: it is a tool to improve
access to information about relevant historical events, allowing users to review the frequency and intensity of previous events for specific geographic regions and includes information on the built environment (via NEXIS) and demographic details (ABS data).

Effective emergency management requires finding the right balance between preventing and preparing for disasters and responding to and recovering from them afterwards. The Impacts Framework, upon which the portal is based, provides a systematic process for understanding the economic, social and environmental impacts associated with fire emergency and natural disaster events. This allows detailed planning options for managing emergencies to be explored in terms of a cost-benefit analysis.

There are a number of areas of future work. Some are obvious: the data items available should be extended to cover the gaps identified; the current centralised approach to managing the data items in a data warehouse should be extended to ‘harvest’ data from sources that provide up-to-date information; the 2011 Australian census data recently released by the ABS should be integrated into the portal.

Other ideas for future work include:

- **In-House Deployment**
  The Pilot Impacts Portal should be made available as an application that can be deployed in-house for an agency that wishes to incorporate data items that are not to be made publicly available.

- **Tool to Gather Post Incident Impact Information**
  Develop an online tool based on the content of the Impacts Framework to guide users to create PPRR data items and manage this information in the portal.

- **Report Registry**
  Allow the portal user community to directly contribute information to the portal for others to access. This information would be reports describing events and their impacts and be processed by supporting tools to link the reports to the content of the Impacts Framework. The registry would manage URL links to reports managed by the report owners.

- **Develop Standards for information exchange**
  The Impacts Framework model could be the basis for a standard format for information exchange describing fire emergency and natural disaster data. Tools could be developed to help data custodians with existing data to translate their data into the format required and for new data items to be created in the new format.

**Acknowledgments**

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This was a valuable contribution to the project and thanks go to the participants who attended.

References


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