A conceptual framework for a geo-knowledge tool –
applying contemporary and collaborative Web
concepts to assist park management

A thesis submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy

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August 2012
Declaration

I declare that: except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is a result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Monique Elsley
August 2012
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Despite the expert knowledge, advice and feedback I have received, the views and interpretations expressed in this thesis, unless referenced, are mine and I accept full responsibility for any inaccuracies or omissions it may contain.

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## List of Acronyms

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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>Australian Broadcasting Corporation</td>
</tr>
<tr>
<td>AFAC</td>
<td>Australian Fire and Emergency Service Authorities Council</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>APZ</td>
<td>Asset Protection Zone</td>
</tr>
<tr>
<td>CFA</td>
<td>Country Fire Authority</td>
</tr>
<tr>
<td>CMA</td>
<td>Catchment Management Authorities</td>
</tr>
<tr>
<td>CRC</td>
<td>Cooperative Research Centre</td>
</tr>
<tr>
<td>DDC</td>
<td>Dewey Decimal Classification</td>
</tr>
<tr>
<td>DIKW</td>
<td>Date-Information-Knowledge-Wisdom</td>
</tr>
<tr>
<td>DPI</td>
<td>Department of Primary Industries</td>
</tr>
<tr>
<td>DSE</td>
<td>Department of Sustainability and Environment</td>
</tr>
<tr>
<td>EAP</td>
<td>Environmental Action Plan</td>
</tr>
<tr>
<td>EMZ</td>
<td>Ecological Management Zone</td>
</tr>
<tr>
<td>EVC</td>
<td>Ecological Vegetation Class</td>
</tr>
<tr>
<td>FDI</td>
<td>Fire Danger Index</td>
</tr>
<tr>
<td>FEA</td>
<td>Fire Ecology Assessment</td>
</tr>
<tr>
<td>FMZ</td>
<td>Fuel Management Zone</td>
</tr>
<tr>
<td>FPP</td>
<td>Fire Protection Plan</td>
</tr>
<tr>
<td>FOP</td>
<td>Fire Operations Plan</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Systems</td>
</tr>
<tr>
<td>GKT</td>
<td>Geo-Knowledge Tool</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HEX</td>
<td>Hexadecimal</td>
</tr>
<tr>
<td>HTML</td>
<td>Hypertext Mark-up Language</td>
</tr>
<tr>
<td>IFPRA</td>
<td>International Federation of Park and Recreation Administration</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
</tr>
<tr>
<td>KM</td>
<td>Knowledge Management</td>
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<tr>
<td>KMRt</td>
<td>Knowledge Management Roundtable</td>
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<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>NRS</td>
<td>National Reserve System</td>
</tr>
<tr>
<td>NVM</td>
<td>Natural Values Management</td>
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<tr>
<td>OS</td>
<td>Open Source</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>OSM</td>
<td>OpenStreetMap</td>
</tr>
<tr>
<td>PBEZ</td>
<td>Prescribed Burning Exclusion Zone</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>RSS</td>
<td>Really Simple Syndication or Rich Site Summary</td>
</tr>
<tr>
<td>SECI</td>
<td>Socialization-Externalization-Combination-Internalization</td>
</tr>
<tr>
<td>SWMZ</td>
<td>Strategic Wildlife Moderation Zone</td>
</tr>
<tr>
<td>TRIM</td>
<td>Total Records &amp; Information Management</td>
</tr>
<tr>
<td>UCI</td>
<td>User Contributed Information</td>
</tr>
<tr>
<td>VNPA</td>
<td>Victorian National Parks Association</td>
</tr>
<tr>
<td>WPNP</td>
<td>Wilsons Promontory National Park</td>
</tr>
</tbody>
</table>
Abstract
The research project described in this thesis investigates if access to and utilisation of a park management data archive can be enhanced using the concept of a geo-knowledge tool (GKT). A GKT is regarded to be a digital information or knowledge system that accesses and presents data in part based on inherent geographic attributes. In addition to the existing data archive, the GKT provides access to data not traditionally relied upon by the park management organisation. These alternative data comprise public data repositories that are made available via the Web by organisations and individuals, professionals and amateurs alike, as well as data being contributed by users of participatory Web tools or participants in collaborative projects. The research project assesses if alternative data sources can potentially complement the existing park management data.

The research project builds here on the Web 2.0 notion that information contributed by users (of participatory and collaborative tools) has the potential to enhance existing information. Web 2.0 is the term applied to emergent Web developments that focus on user participation and collaboration. Users are provided with participatory tools that allow them to contribute and share information, and create knowledge. When combining the bits of information contributed by individuals, a so-called collective intelligence emerges. This research project regards users to be broader than just Web users, and instead embraces, for example, park visitors, staff, the public at large and other organisations. Assessing if information contributed by users has the potential to complement the existing park management data is consequently similarly viewed from a broader perspective, and encompasses existing data repositories accessible via the Web – information contributed by organisations, governments, the media, the general public and the like.

The initial objective of the research project is to make better use of the existing park management data archive through enhanced data access. Additionally, the project examines if alternative data sources can complement the existing data, and potentially fill information gaps or improve knowledge. Can traditional and non-traditional data be integrated to become part of an effective GKT that can benefit park management and assist decision-making?

In order to fulfil the objectives, the research project develops a theoretical methodology for a GKT as a means for accessing data. Parks Victoria is a collaborator on the project.
Wilson’s Promontory National Park, one of the parks it manages, and data related to fire management and planned ecological burning are used for a case study. The methodology comprises a conceptual model and a demonstration prototype. The former gives a broad overview of the system, and identifies relevant linkages between different aspects and issues encountered. It incorporates concepts of emergent Web developments including the aforementioned Web 2.0 as well as developments in the geospatial realm. Through geospatial platforms and mapping tools like Google Earth and Google Maps, geospatial information can be accessed and displayed in a variety of ways via the Web or on mobile devices. Emerging terms like ‘volunteered geographic information’ and ‘user generated geo-content’ highlight that a geographic element is inherent in many Web 2.0 tools and applications, and the ensuing user contributed information. The research project explores if these contemporary Web concepts can benefit the GKT and contribute to an effective interface for data access.

Following the conceptual model of the GKT, a demonstration prototype is developed to evaluate the theories being applied and to help envisage what a GKT could potentially achieve. A number of stakeholders review the prototype and provide feedback on the concept and underlying theories, as well as the overall design and usability. The results show that the proposed GKT has the potential to become an effective tool for accessing existing georeferenced data and for finding unknown data. Having easy access to alternative data through the GKT – in addition to the park management data –, could further support users that require such data.

Although the research project used the data archive of a park management organisation to develop the conceptual GKT and the demonstration prototype, it is argued that the research’s primary outcome can be applied to other areas and fields and benefit organisations that face similar issues to those the research project is based on. Similarly, the notion that alternative data can potentially benefit existing data can be applied to other areas. It is further proposed that the amalgamation of existing and alternative data does not have to diminish the scientific rigour and professional approach to existing practices provided certain issues be considered. The theoretical framework for a GKT that this research project develops is therefore flexible and adaptable, and can accommodate newly emerging concepts and technologies. Amalgamating traditional organisational and alternative data has the potential to benefit users, and to enhance practices and decision-making.
Chapter 1. Introduction
The aim of this research project was to develop a theoretical methodology for providing enhanced access to and utilisation of such an extensive data collection. The concept of a geo-knowledge tool (GKT) was used as a data interface for enabling data access; a GKT was considered to be a digital ‘knowledge system’ that in part uses the geographic attributes to find and present data. The theoretical methodology to be developed considered concepts of emergent Web developments – Web 2.0 and the GeoWeb – in its design, to investigate if they could contribute to an effective GKT.

Parks Victoria, the organisation that manages parks on behalf of the Victorian Government in Australia, was a collaborator on the research project. The organisation’s

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existing data archive was applied as a case study for the development of the theoretical methodology for a GKT.

This chapter broadly discusses the background to the research project and gives an overview of aspects of the research (some of these are discussed in more detail in ensuing chapters). The first section describes the underlying issue from Parks Victoria’s perspective. The next section briefly examines the emergent Web concepts that were to be considered for the GKT. This is put in the context of the research project, and why these notions, and in particular the participatory and collaborative aspects of Web 2.0, were being considered is discussed. This is followed by a discussion on alternative data sources and their consideration for the theoretical methodology for the GKT. As Parks Victoria is a government organisation, ‘Government 2.0’ is briefly touched on in the next section to summarise the Australian and Victorian State governments’ adaptation of Web 2.0. The ensuing section is a deliberation on undertaking research in a fast moving area that the realm of Web 2.0 turned out to be. The final sections describe the research project, and outline the research questions and the research approach taken as well as the scope of the demonstration prototype. The chapter concludes with an overview of the six ensuing thesis chapters.

1.1 Background

Parks Victoria has an expansive archive of data relating to its parks and reserves that have been collected over the years. The data comprise different formats such as paper reports and maps, digital files and photo and video collections. They are stored in various databases, information systems or filing cabinets, on optical storage devices or desktop computers, centrally or locally. They are accessible to some or all staff or, if appropriate, to other stakeholders, visitors to Parks Victoria’s website\(^3\) or visitor centres in parks. Some data are so ‘local’ that their mere existence is only known to people involved in their creation or those working in the same office. Parks Victoria’s data are inherently georeferenced. For example, they can be connected to the whole park network, one or more individual parks, or a location, area or route within a park.

Park managers globally face the challenge of gaining access to appropriate data, when and where they are needed. This is compounded due to loss of tacit knowledge through ageing workforces and an increasing number of qualified staff with expert knowledge

\(^3\) Refer parkweb.vic.gov.au/
nearing retirement age (Gettler 2010; Parks Victoria 2009f). Those working at Parks Victoria are no exception. The role of park management agencies has also expanded and instead of primarily focussing on environmental management, park rangers are expected to possess wider skills that allow them to work in a more complex environment (Parks Victoria n.d.-b).

To address the underlying issue, the research project investigated if Parks Victoria’s existing park data could be utilised more effectively, and if data access could be enhanced so park managers could find and consider data appropriate to their needs when required. In addition to making better use of the existing park management data, the research project also investigated if alternative data sources could complement or benefit the data. Examples of non-traditional data sources include data found on the Web, and information contributed by staff members and stakeholders using collaborative communication tools. The ensuing section describes these in more detail.

1.2 Emergent Web concepts

Web 2.0, also referred to as the New Web or Social Web (Tapscott and Williams 2008), is the term applied to current Web applications that encourage user participation and collaboration, resulting in potentially valuable information being contributed by users (Hardey 2007; O'Reilly 2005; Short 2008). The notion of ‘user’ implies Web users, but in broader terms can refer to staff, visitors, clients, other companies etcetera that collaborate and contribute information via participatory tools and applications.

Web developments in the geospatial realm reveal an increased importance of location technologies (Gordon 2007; Unwin 2008). Through geospatial platforms and mapping tools such as Google Earth and Bing Maps, people are able to access and display georeferenced information in a variety of ways via the Web or on mobile devices. Information generated with location aware devices such as GPS enabled mobile phones and cameras increasingly contain geographic attributes. Using the term ‘Where 2.0’, O’Reilly (cited in Turner and Forrest 2008) highlights the geographic aspect inherent in many Web 2.0 applications and information contributed by users.

The research project considered geospatial Web developments to deal with the ‘geo’ component of the GKT, whilst the reason for taking into consideration concepts of Web 2.0 are being addressed in the following sections.
1.2.1 Collaboration and knowledge creation

The essence of Web 2.0 is user participation and collaboration, and the potential value of the resulting user contributed information (UCI). These notions of Web 2.0 are increasingly being applied in a wide range of organisations and fields (Dawson 2009a; McAfee 2006), at different levels and for various purposes, in part because the potential benefits for knowledge creation are recognised. Knowledge is stimulated through active engagement; the participatory Web 2.0 tools can be effective means to share information and create knowledge (Weinberger 2007).

O'Reilly (2005) states that organisations that employ Web 2.0 concepts utilise users’ contributions and collaboration to gain by collecting their collective intelligence, a key factor of Web 2.0 (Chatti and Jarke 2009). It is suggested that UCI can potentially enhance or enrich existing information (O'Reilly 2005; Vickery and Wunsch-Vincent 2007). This could in turn benefit all users of the information and, if applied to Parks Victoria’s existing data, could assist in the management of parks. Therefore, in addition to developing a methodology for accessing Parks Victoria’s data archive, the research project examined if UCI in a broad sense could potentially complement the organisation’s existing data.

According to Larrucea et al. (2008), one of the contemporary concerns of organisations is collaboration. This is due to the increased globalisation of opportunities and competition, which means that productivity and innovation need to be enhanced at various levels; from personal and team to partner and stakeholder level. It is also important for organisations to engage different stakeholders for data collection and management (Allemang 2010), which means data can become disconnected from other data. The concept of Web 2.0 can assist in “breaking down the barriers between siloed business groups and in making valuable corporate information and organizational intelligence more accessible, searchable and more easily shared” (Short 2008, p. 30). Vickery and Wunsch-Vincent (2007) concur, stating that as Web 2.0 is growing in use, research and technology will develop accordingly and impact on organisations’ productivity, behaviour and structure. Allemang (2010) further argues that the notion of having one database as the central source of information is outdated. Instead, people expect to obtain information from different sources. Therefore, in an ever-digitised world, a tool like the proposed GKT that gives users access to both traditional and alternative data sources, is arguably in line with current expectations and could enhance
existing information management practices. Additionally, the attraction of Web 2.0 to achieve collaborative practice outcomes would similarly seem to be beneficial, whether between staff members, departments or with business partners or by engaging and collaborating with clients or the community.

1.2.2 Existing practices and new concepts

It is argued that as new concepts emerge, it is important to look at these and consider them for one’s own field or organisation. This in turn means that existing practices and policies may need to be re-examined or new ones developed to suit the new environment. New concepts also need to be tried and tested so that they can be effectively adapted to different areas. Libraries (e.g. Byrne 2008; Mackenzie 2008) and education facilities (e.g. Cooper-Simon 2008; Trinidad and Broadley 2008), for example, have started to utilise the latest collaborative and participatory Web 2.0 notions to suit their needs. The phenomenon dubbed Enterprise 2.0 (McAfee 2006) indicates that the incorporation of social media tools by organisations into their daily business has become a more widely accepted practice (Hinchcliffe 2007). Similarly, special projects have been conducted based on the collective intelligence principle and non-experts have been consciously employed to contribute data through what is known as crowdsourcing (Howe 2006) (see Chapter 2.3).

This research project investigated if these emergent Web 2.0 concepts and theories could be applied to the park management sector, and how they might benefit existing expert park related data, park management and decision-making. The research project also stepped away from Parks Victoria’s traditional practice of data provision. Instead of merely relying on the organisation’s own data and data from trusted experts and partners, the project considered alternative data sources not generally considered by the park management organisation in its decision-making.

1.2.3 Applying non-traditional data sources

It is argued that the arrival of the World Wide Web (the Web in short), followed by the concept and practices of Web 2.0, has seen a shift in the methods of information provision and knowledge acquisition (see Figure 1.1). The hyperlinks of the Web have provided the opportunity to easily access a wide variety of information from a range of sources, often with opposing viewpoints (Vanpée 2002; Zimmer 2009). People can consider different information and form their own opinion, instead of relying on a
smaller number of ‘expert’ knowledge sources as was traditionally the case. As Allemang (2010, p. 4) points out, people are expecting “a web of interconnected information” instead of just one data source. The arrival of Web 2.0 has increased the number of data sources for knowledge creation further. Users of participatory tools, experts and non-experts alike, are contributing information and have become sources for others to consider and on which to base their knowledge.

Bearing in mind this increase in available data sources, the research project explored the Web 2.0 notion that UCI can benefit existing data. Just as ‘users’ were regarded to be broader than just Web users, UCI for the purpose of the research project was also considered from a broad perspective. It included data found on the Web in so-called public digital data archives – created and made available by organisations, media outlets, governments, businesses and the like or by the general population through social media applications like blogs, wikis, feedback forums and photo-sharing sites.

The proposed GKT therefore would provide access to Parks Victoria’s existing data as well as alternative data found on the Web or contributed by users of participatory Web based tools or participants of collaborative projects. The research project assessed if these existing digital data sources could potentially complement Parks Victoria’s existing database, and thus whether non-traditional data sources could be amalgamated with mainstream data to support park management. Figure 1.2 shows examples of
potential data sources that an organisation’s GKT might draw upon. The data depicted by the lighter grey/white boxes (to the left and at the top) are organisational data, some of which, traditionally, can be more easily accessed than others. The remaining data sources represent alternative data sources that can be found on the Web or be obtained through participatory means. An elaborated version of Figure 1.2 adapted to Parks Victoria and the case study area is explained in detail in Chapter 5.4.1.

Figure 1.2 - Potential data sources that could be used for a GKT.

1.2.4 Government 2.0

Parks Victoria is a government organisation – it manages parks on behalf of the Victorian State Government. Governments are also using Web 2.0. Like Enterprise 2.0 for businesses, the term Government 2.0 has been applied to the adaptation of Web 2.0 into government. At an Australian Federal level, one of the nine key promises in the Australian Government 2.0 Taskforce’s final report is “involving communities of interest and practice outside the public sector – which offer unique access to expertise, local knowledge and perspectives – in policy making and delivery” (Government 2.0 Taskforce 2009, p. xii). The State Government of Victoria under former Premier John Brumby, ousted in November 2010, employed weekly videos with news from Parliament sittings and used Web 2.0 applications to connect with citizens in the recognition that these tools are increasingly being used by the community (The Premier of Victoria 2010). Similarly, the current Victorian Government under Premier Ted Baillieu, at time of writing, employs popular social media applications like Facebook,
Twitter and YouTube. It also joined Weibo in April 2012, a Chinese social media site that connects with Chinese constituents (Cai 2012). Chapter 2.3.3 gives more detailed examples of the adoption of social media tools into society and how they are used by governments.

Near the start of the research project, in May 2009, Parks Victoria had just commenced a trial version of Microsoft’s SharePoint – commercial software to encourage staff collaboration and sharing. Additionally, the organisation at the time experimented with a participatory Web based application for the drafting of the Alpine Management Plan to engage with and obtain information from the community (both are discussed in more detail in Chapter 4). It appeared therefore that Parks Victoria had taken initial steps towards considering the emergent Web 2.0 developments and arguably recognised that collaborative and participatory tools “can be important tools to improve the efficiency of knowledge worker collaboration” (Vickery and Wunsch-Vinet 2007, p. 63). This research project supported these initiatives by providing further insight into the potential benefits related to the adoption of a collaborative approach.

1.3 Research in a fast paced area

It must be noted that Web 2.0 has developed fast and uptake of its concepts, through associated tools and applications, has grown enormously since the research project commenced in March 2009. When the initial research proposal for the overarching research project was developed, Web 2.0 was still relatively novel and new. Particularly from an Australian perspective, it was regarded to be in its infancy with relatively few people and organisations actively using social media applications or considering their benefits. When investigating what Web 2.0 entailed during the first phase of the research in 2009, the author wrote initial proposals that Parks Victoria should join key social media applications to gather UCI and communicate with park visitors and the public at large. Recommendations made by the author following the results of the park visitor survey conducted in September 2010 similarly proposed that it would benefit the organisation to do so. Of course, in March 2011 Parks Victoria did exactly that. The organisation joined four major Web 2.0 applications – Facebook, Twitter, Flickr and YouTube – whilst its public website was upgraded later in 2011 to

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4 The PhD research project outlined in this thesis falls under the umbrella of Affective Atlas (Cartwright et al. 2008), an interdisciplinary research project undertaken at RMIT University in collaboration with Parks Victoria that was first proposed in 2007.
include participatory and collaborative features. Similarly, Web 2.0 itself has grown. The notions it embraces have found their way into many parts of society, in people’s private world as well as in those of governments and businesses – as described in more detail in Chapter 2 – to the extent that it seems impossible for the trend to be reversed, and for the Web to not be participatory and collaborative anymore.

This research and its outcomes must be viewed within this context and the difficulties that exist with undertaking research in a fast moving area such as Web 2.0.

1.4 The research project

The objective of the research project was to enhance access to and utilisation of an existing, georeferenced data archive. This was achieved by developing a methodology for a GKT as a means to access data. The research explored whether applying contemporary Web concepts could benefit such a tool and contribute to an effective interface for data access. Additionally, the research project examined whether alternative data sources that included data available on the Web have the potential to complement the existing data archive, enhance knowledge or fill information gaps. The research undertaken assessed if traditional and non-traditional data can be integrated to potentially enhance decision-making support.

1.4.1 Research questions

The research project’s main objectives were encapsulated by a number of research questions. The four key research questions are listed below, and are followed by three secondary research questions that needed to also be addressed to complete the research.

Key research questions:

1. Can a digital archive that contains georeferenced data in different formats be effectively visualised to represent knowledge?
2. Can non-traditional data sources be amalgamated with mainstream data to form part of an effective digital knowledge tool to potentially assist decision-making?
3. Can the alternative data accessible through such a tool potentially complement existing data, improve knowledge or fill information gaps?
4. Can contemporary Web concepts be successfully applied for the development of the tool?
Secondary questions:
i. How can different user groups access and utilise the archive appropriately?
ii. Can different user groups maintain and add to the system’s data content?
iii. What methods or principles could assist in assessing the data quality of alternative data sources?

1.4.2 Research outcomes

The primary outcome of the research project is a methodology for a GKT. A GKT was regarded to be a digital knowledge system that, in part, uses geographic attributes to access and present both traditional and non-traditional data. The GKT was designed with contemporary participatory and geospatial Web concepts in mind. At completion of the research project it was assessed if these concepts can be applied to access, organise, collect or visualise georeferenced data and contribute to an effective GKT. It was also evaluated whether non-traditional data can potentially complement traditional data.

The research outcomes contribute new insight into the adaptation of Web 2.0 concepts and the opportunities and issues that arise from adopting a collaborative and participatory approach. This is relevant because of the relatively early stage, particularly in Australia at the commencement of the research project, of uptake within organisations. Various disciplines had started to use Web 2.0 concepts, but no examples were found in the broader environmental management realm in Australia. Through the case study of Parks Victoria, the outcomes can specifically assist in assessing whether these emergent concepts might benefit park management and whether alternative data, relevant to park and fire management, might potentially complement existing park management data. With this, the research project also applied a new approach for Parks Victoria, which traditionally has relied on expert data from trusted sources. The outcomes of the research are regarded to have broad potential to change how organisations like Parks Victoria might collect data and the concepts are capable of being applied or adapted to organisations in other areas and to other fields.

1.4.3 Research approach

The approach applied to the research consisted of a series of steps, accumulating in various activities. These were separated into an initial exploratory phase for information gathering and the implementation phase that focused on the development of a
A theoretical methodology for a GKT. The latter comprised a conceptual model and a demonstration prototype to assess the theories underlying the research. The implementation phase used a case study to manage the task on hand. Wilsons Promontory National Park (WPNP), one of the parks managed by Parks Victoria, was the study area and data relating to fire management and ecological planned burning were used as the basis for the conceptual GKT and the development of the demonstration prototype.

The exploratory phase contained three main activities primarily aimed at gathering background information. These were:

1. **Review of existing literature and publications**
   - This included investigations into Web 2.0; park management; knowledge and knowledge systems; and traditional and contemporary theories for presenting georeferenced information. Examples of projects and applications that incorporate notions of Web 2.0 or apply Web based geospatial technologies were also examined;

2. **Site visits to Parks Victoria Head Office**
   - This assisted in obtaining background information about the organisation as well as details relevant to the research project, such as existing data and information systems and insight into practices like knowledge management, collaboration and decision-making. The initial focus was general and shifted to the more specific application of fire management and planned ecological burning for the case study. The site visits became a generally weekly occurrence and continued throughout the duration of the research project; and

3. **Site visits to WPNP**
   - These were essential for gathering more in-depth information on the focus area, WPNP, and on aspects relating to fire management at a local level. Visits commenced early in the research, as part of the initial information gathering phase, and took place irregularly throughout the duration of the research project as required.

The second implementation phase focused on carrying out the primary goal of developing a methodology for a GKT. The two primary activities were supported by a number of tasks to assist the development of the conceptual GKT and the ensuing demonstration prototype. The main activities and tasks were:
4. Develop a conceptual GKT based on findings from the initial investigative phase and four supporting tasks. These four were:
   i. Conduct a visitor survey at WPNP, aimed at seeking feedback from park visitors on their views and use of Web 2.0 and their perceived willingness to participate and contribute information;
   ii. Investigate data requirements and decision processes for fire management and planned ecological burning, from an organisational level down to WPNP’s level;
   iii. Examine non-traditional data sources potentially relevant to the case study with a focus on existing data archives on the Web; and
   iv. Develop a methodology for assessing data quality and/or usefulness. This was regarded a requirement due to the inclusion of alternative data sources upon which a GKT could draw.

5. Build a demonstration prototype based on a portion of the conceptual GKT and using selected data. Please refer to the ensuing section for the perceived scope of the demonstration prototype. Once complete, the following two tasks remained:
   i. Review of demonstration prototype by stakeholders for feedback on underlying concepts and usefulness of the tool, as well as general design and usability; and
   ii. Analyse feedback received from reviewers and amend demonstration prototype as appropriate. If required, the modified demonstration prototype could be reviewed again.

1.4.4 Scope of demonstration prototype

The demonstration prototype was a partly interactive, simplified model of a GKT. It incorporated aspects of the conceptual GKT that was developed, and focused on fire management and ecological planned burns for detailed requirements. The purpose of the demonstration prototype was to demonstrate a concept and to assess the theories being applied by the research project. The research’s objectives were to provide access to both traditional and non-traditional data and assess if access to the latter can potentially complement the former. When putting these objectives in the context of the case study and applying them to Parks Victoria, the following three questions emerged:

1. Is the proposed GKT a means to make better use of Parks Victoria's data by providing access to all data categorically using one tool?
2. Can the alternative data accessible through the GKT potentially complement Parks Victoria’s existing data, improve knowledge or fill information gaps?
3. Does the application of contemporary Web concepts benefit the tool?

The demonstration prototype enabled appropriate stakeholders who reviewed the model to address these questions. The prototype gave access to both existing Parks Victoria data and alternative data, giving reviewers the opportunity to assess whether the proposed GKT was an enhanced access method to Parks Victoria data whilst also enabling them to form an opinion on the potential usefulness of having integrated access to traditional and non-traditional data sources.

Because its purpose was to demonstrate a concept, the demonstration prototype was never developed to be a fully functional, technologically advanced prototype. It therefore, for example, did not provide access to real ‘live’ data, nor did it have a full array of interactive user tools and functionality that a GKT was envisaged to possess. Instead, it provided a snapshot of a portion of a system that could be. It was developed to a sufficient level to enable reviewers to address the questions posed and assess the underlying theories. Should the prototype, combined with the conceptual GKT, be considered a potentially useful and efficient tool, Parks Victoria as an organisation could decide whether to continue with the development of a more advanced prototype that incorporates more or different data and functionality, or to develop the conceptual GKT or parts thereof into a working model.

1.5 Overview of chapters
This thesis consists of seven main chapters, commencing with this introduction. A brief summary of the ensuing chapters’ content is described next.

Chapter 2 – Web 2.0: User Participation and User Contributed Information – discusses Web 2.0 in general terms and outlines the concepts of user participation and UCI. It gives a summary of changes in communication technologies and new media that have occurred, ending with today’s new social media. The concepts of collaboration and collective intelligence are described in more detail, including examples of projects that have applied these notions in order to capture the collective intelligence of individuals. The Where 2.0 section connects Web 2.0 with Web developments in the geospatial
realm, whilst the final part of the chapter discusses a number of issues associated with Web 2.0.

Chapter 3 – Knowledge and Knowledge Systems – commences with basic elements of knowledge such as the transformation from data to knowledge and how to capture knowledge, at times putting this within the context of Parks Victoria. The ensuing sections describe the gradual development of knowledge systems. It begins with so-called synthetic knowledge systems that encompass information and knowledge organisation and classification, hypertext and geographically oriented knowledge systems. The next section focuses on the Web as a knowledge system through linking of information, which is followed by collaborative knowledge systems that discusses collaborative concepts found in knowledge management, knowledge sharing and Enterprise 2.0. The final step adds a geographic aspect to knowledge systems. Geospatial Web developments are discussed, whilst the basics of geographic information, maps, and map metaphors to visualise non-geographic information are also described. A number of projects and applications that apply geographic visualisation methods and crowdsourcing to present information and knowledge are examined.

Chapter 4 – Park Management, Parks and Park Data – discusses park management in general including a brief history of the national park movement and how parks are managed in Australia. Moving to Victoria, an overview of the park system and main legislation in the State is listed before focussing on Parks Victoria as an organisation. The chapter outlines the organisation’s structure, management areas, goals and strategy, and current information systems before exploring Parks Victoria’s collaborative and community engagement practices. A number of examples of methods for providing and capturing park related data, by Parks Victoria and elsewhere, are described.

Chapter 5 – Case Study: Wilsons Prom, Fire Management and Planned Ecological Burns – focuses on the case study component of the research project. It outlines the study area, WPNP, and the topic of focus, fire management and planned ecological burning. Aspects of fire management, decision-making and planned burns are discussed, and fire management data requirements at various levels are listed. Alternative data sources are also explored, with examples of potentially relevant existing digital data archives examined. The results and an analysis of a park visitor survey conducted at
WPNP is described next, with park visitors regarded as an alternative data source that can contribute potentially valuable information. The implementation phase is represented by an overview of the conceptual GKT and its various components, whilst two issues that from part of the conceptual model are explored further and theoretical solutions put forward. The process for developing the demonstration prototype is outlined in detail; it describes the development of a use scenario, data needs, and considerations for the interface design whilst concluding with the review process of the demonstration prototype by stakeholders.

Chapter 6 – Analysis and Discussion – analyses the feedback received from reviewers of the demonstration prototype. It details the written and verbal feedback and discusses how key issues identified relate to the conceptual model or a future GKT. The research questions are addressed considering all relevant findings from the review of the demonstration prototype as well as other activities and tasks undertaken during the research.

Chapter 7 – Conclusions and Recommendations – reflects on the outcomes of the research and proposes areas for future research work. It firstly discusses the application of the research to other areas and disciplines, and reflects on what the potential implications of adopting Web 2.0 are. The research outcomes are then expressed in relation to the contributions of the research project, and four recommendations for future research work are proposed. The chapter concludes with a reflection on the evolving Web developments from Web 2.0 to Web 3.0 or the Semantic Web. It considers whether the conceptual GKT developed can be adapted to suit the newly emerging semantic notions of Web 3.0.
Chapter 2. Web 2.0: Participation, Collaboration and User Contributed Information
2.1 Chapter overview

The research project considered concepts of contemporary Web developments for the design of a conceptual GKT. These Web developments encompass the geospatial realm – to deal with the ‘geo’ element of the tool – and the participatory and collaborative notions of Web 2.0. As already outlined in the Introduction chapter, since this research project commenced, Web 2.0 has grown and concepts associated with the phenomenon have found their way into many parts of society – in people’s private world as well as in those of governments, businesses and other organisations. This chapter describes what Web 2.0 is about and how aspects of it have been and are applied for different purposes. The purpose of the chapter is to create the theoretical foundation for considering Web 2.0, and to explain some of the related underlying theories the research project is based on. Furthermore, the investigation into Web 2.0 that was conducted to write this chapter is regarded to have strengthened the case for considering these same notions for the research project, whilst the examples of projects and applications that utilise Web 2.0 have provided background information to be taken into consideration for the design of the GKT.

This chapter firstly describes Web 2.0 in general terms, and expands on the associated key concepts of user participation and user contributed information (UCI). It continues with a brief history of changes in communication technologies and new media, to arrive at the new media of today – social media or Web 2.0 and the emergence of social networks. The notions of collaboration and collective intelligence are discussed, and examples of projects that have adopted these concepts in an attempt to capture the resulting UCI and their collective intelligence are described. The ensuing Where 2.0 section provides a link between Web 2.0 and the Web developments in the geospatial realm, and highlights that Web 2.0 comprises a growing geographic element (these ‘geographic elements’ will be discussed in more detail in Chapter 3.6). Although it is argued that the emergence of Web 2.0 is generally regarded as positive, the final part of the chapter briefly outlines a number of issues associated with Web 2.0.

2.2 What is Web 2.0?

The term ‘Web 2.0’ was first used by DiNucci (1999, p. 32) when stating that the “…Web we know now, which loads into a browser window in essentially static screenfuls, is only an embryo of the Web to come”. The term became more widely used
after an O’Reilly Media employee applied it during a meeting in 2004 in an attempt to define how the Web and its applications had changed (O’Reilly 2005), particularly after the collapse of the so-called dot-com bubble. Web 2.0 thus broadly refers to the way the Web now operates with websites and applications that focus on user participation. It has subsequently also been referred to as the “New Web” (Tapscott and Williams 2008, p. 2), the “Social Web” (Kamel Boulos and Wheeler 2007, p. 2) or “participative web” (Vickery and Wunsch-Vincent 2007, p. 15), whereas Web 2.0 tools and applications are commonly labelled as social media tools. Use of the term Web 2.0 became so common that it was declared the millionth word in the English language by a language monitoring group in June 2009. This was not without criticism however, partly because it was deemed impossible to accurately count the one millionth word (Goldsmith 2009; Simmons 2009), but also because some considered the term already past its usage and new concepts were taken its place (Schonfeld 2009). Related to the latter perhaps, is that not everyone is necessarily enthusiastic about the Web 2.0 phenomenon (Kroski 2006), and wonder if it is merely a hype or marketing plot (O’Reilly 2005).

Despite criticisms of Web 2.0, or perhaps more accurately the (over)usage of the term, it is generally recognised that the way the Web and Web technologies and applications now work is not the same as they did, say, in the 1990s (Connolly 2000; Harrison and Barthel 2009). One of the major differences that can be observed is the ability by users to actively participate and collaborate (Fadaghi 2008; Hardey 2007). Hardey (2007, p. 869) states that “Web 2.0 is inherently social so that users are central to both the content and form of all material and resources”. Whereas the Web in the early days was more a tool to access information provided to passive users in the form of Web pages (Tapscott and Williams 2008), these same Web users can now actively participate and contribute to its content in a variety of ways.

Web 2.0, according to O’Reilly (2005), is in essence a set of principles and practices that are being applied, to varying degrees, in applications and technologies. As such, Web 2.0 should not be seen as a technology itself (Krasne 2005), but rather as a concept containing a series of principles (Anderson 2007; O’Reilly 2005). Harrison and Barthel (2009) describe it as a platform, where users simply need a computer or mobile device to access and utilise the resources provided (Hardey 2007). Organisations that employ

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5 The dot-com bubble refers to the fast rise of companies and stock prices in the Internet sector (Ofek and Richardson 2003) and their subsequent fall.
Web 2.0 principles should actively seek this user participation and in some cases may entirely rely on it. The online auction site eBay\(^6\) for example, would not exist if it were not for its users (Tapscott and Williams 2008), and the site grows bigger and stronger the more users contribute (O'Reilly 2005). Weinberger (2002) states that the Web in general is gaining value every time users interact. Therefore, the emergence of increased user participation and collaboration has not only increased value for individual sites, it has increased the worth and significance of the Web as a whole.

2.2.1 Why has the Web changed?

What are the reasons for these changes in the Web? It can be argued that it is simply a natural development of the way the Web was meant to be. Initial technological difficulties may not have allowed for users to be active participants, as software developed and the potential of the Web became clearer to a larger audience, it was inevitable that that initial goal of user participation as outlined by its inventor Tim Berners-Lee (Berners-Lee and Fischetti 2000) became reality. Hardey (2007) suggests that it was the economic downturn after the collapse of dot-com enterprises that paved the way for a different approach to the Web and the opportunities it held, in other words, a shift to what would become Web 2.0 principles. The recognition that user participation potentially provides benefits for businesses (O'Reilly 2004; Tapscott and Williams 2008), the ability to gain revenue from advertising on the Web through, for example, Google’s AdSense (Hardey 2007), and an increased development of Internet software that facilitates user participation through tools and services that are accessible through Web browsers (Godwin-Jones 2008) perhaps all have in their own way contributed to the growth of Web 2.0.

Despite its potential, Web 2.0 and its associated ideals are not regarded positively by everyone. Tapscott and Williams (2008, p. 271) outline that “… proponents … see the Internet’s democratizing tendencies as a positive force that is broadening access to knowledge, power and economic opportunity, its critics see it as a flattener of culture, an enemy of expertise, and a destroyer of wealth and property”. Examples of negative aspects are the supposed lack of quality of information contributed by users and copyright issues, and will be discussed in more detail in the final section of this chapter (see section 2.5).

\(^6\) Refer \url{www.ebay.com}. 
2.2.2 User participation

Web 2.0 is about user participation. Users participate, collaborate and communicate with others across a range of Web enabled platforms including mobile devices. They create content not just for themselves but also for other users to see and reuse through distribution and sharing (Harrison and Barthel 2009). Communication and collaboration between Web users has never been easier, and, according to Tapscott and Williams (2008, p. 3), people “…can now actively participate in innovation, wealth creation, and social development in ways we once only dreamed of”.

It has been argued that users were able to participate in the past through what is known as the read-write Web (Harrison and Barthel 2009). Users, for example, could start their own website. However, this group was limited in numbers as they had to have some knowledge to be able to do so such as writing hypertext mark-up language or HTML code, the formatting language for the Web (Godwin-Jones 2008). This was made easier with the arrival of appropriate software like the then Macromedia suite containing Dreamweaver and Flash (now Adobe), though this was licensed and not cheap to purchase. The difference with Web 2.0 applications is that users do not necessarily require any special software or knowledge (Harrison and Barthel 2009). Applications such as blogs, eBay, YouTube7 and Flickr8 allow anyone, in theory at least9, to participate. More importantly, Web 2.0 is also based on actively seeking and wanting users’ input; its essence is that users actively participate rather than merely passively looking up existing information (Tapscott and Williams 2008), a so-called “architecture of participation” (O'Reilly 2005, p. 7). The Web was always intended to be a means for users to participate through writing (Berners-Lee and Fischetti 2000), “an information space, with the goal that it should be useful… for human-human communication” (Berners-Lee 1998, para. Introduction). Berners-Lee (cited in Lawson 2005) recognises that the shift from relatively complicated HTML code to user friendly tools like blogs and wikis that allow people to simply write text as if they were writing a

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7 Refer www.youtube.com.
9 Some have argued that access is not the same for everyone (Jenkins 2008), and that apart from a Digital Divide, there is now also a Participation Divide. The term Digital Divide describes the inequality in access to digital technology, and the subsequent foregoing of potential benefits derived from such access by those being excluded (Digital Divide.org n.d.). Participation Divide means that low level participants will miss out on developing “people’s skills necessary for functioning well in the contemporary workplace and for diversifying creative and cultural production (Hargittai and Walejko 2008, p. 241).
letter or email has made that goal easier, and has resulted in an apparent irreversible trend allowing Web users to participate.

2.2.2.1 User contributed information

Resulting from user participation and collaboration, people are contributing information – termed UCI or ‘user contributed information’ by the research project. Users are central to Web 2.0 and Web 2.0 applications thrive on UCI. Applications like the aforementioned eBay and YouTube would simply not exist if users would not participate and generate UCI. According to O’Reilly (2005), users add value to sites, whether by explicitly contributing information or merely by leaving a trail of their normal behaviour. This can be ‘mined’ or ‘scraped’ by others and used for marketing or business purposes or to personalise searches, in effect enhancing the user’s experience in future visits. Web scraping in simple terms is a means to extract the useful bits of information hidden in the computer code representing the data provided (Iskold 2007). Carr (2006) describes this as “collecting the crumbs” that users leave behind when visiting sites, which is part of the value users contribute. Shirky (2008) points out that it is not merely the creating of content that defines UCI, its essence is also to share or distribute it with others. Users therefore need access to both creative tools as well as tools that allow them to share their creations. The former consists of writing and drawing software, provided by Microsoft or Adobe for example, whereas the latter has emerged through Web 2.0 applications like blogs, wikis and photo- and video-sharing sites.

Users contribute information for different reasons. Research shows that technological, social and economic factors are at play (Vickery and Wunsch-Vincent 2007). The technological factors seem straightforward: the growth of broadband, increase of processing speeds, and the availability of appropriate technologies, tools and software. The economic drivers partly relate to all this, for example, the reduction of cost for broadband connections and the relatively low cost to access and utilise the software. Additionally, an increase in business interest and the potential benefits UCI holds plays a role. Social factors include a younger generation that has been brought up with computers (Tapscott and Williams 2008), who have a “willingness to engage online… and [are] less hesitant to reveal personal information online” (Vickery and Wunsch-Vincent 2007, p. 28). This generation also wants to participate more actively than more traditional media are providing (Jenkins 2008). It is perceived that these attributes of the
younger age group are spreading to older generations\textsuperscript{10} with increased numbers using social media tools (Warr 2008). Reasons for participation include a desire to communicate with peers, to express oneself artistically, or to seek fame or prestige (Vickery and Wunsch-Vincent 2007). Social network sites can cater to the former, whereas specialist photography or art blogs are examples that provide for the latter two reasons.

\subsection*{2.2.3 Key Web 2.0 applications}

A range of Web 2.0 applications and tools has now widely been adopted, and some social media tools have become part of everyday life for sections of the population. A number of tools and features are generally regarded to encompass Web 2.0 (Anderson 2007; Huyse 2007). These are social networking sites for sharing multimedia, blogs, wikis, podcasting, RSS and social bookmarking sites. Additionally, the concept of tagging is an important feature in many of these Web 2.0 applications.

\subsubsection*{2.2.3.1 Social networking sites}

Social networking sites allow users to add different media, personal profiles and a host of other information for the purpose of sharing this with peers. Some arguably better known applications are Facebook, MySpace and LinkedIn\textsuperscript{11}, although many more active social networking sites exist. These sites focus on peer-to-peer\textsuperscript{12} communication networks and social interaction, enabling users to connect with friends and colleagues (Vickery and Wunsch-Vincent 2007), or in the case of LinkedIn with like-minded professionals and business people (Warr 2008). Some sites are multimedia sharing sites that let users upload only specific media types like videos, photos or music. Examples are YouTube for sharing videos and Flickr for sharing photos. Warr (2008) further describes ‘social guides’ that focus on specific interests like travel or dining. TripAdvisor and Urbanspoon\textsuperscript{13} are examples of social guides for sharing personal

\textsuperscript{10} An article in Melbourne’s The Age newspaper reported in February 2010 that applications like Facebook and MySpace are increasingly used by older people – see www.theage.com.au/national/social-networking-faceoff-as-over55s-catch-up-and-teenagers-log-off-20100213-nyj8.html. And 2011 statistics indicate that although still less than the younger generation, around 60\% of people aged 40-49 and about a third of people aged 50 and over use social media (Sensis 2011).


\textsuperscript{12} Peer-to-peer (P2P) networks in this context refer to communication structures where individuals are equal in their ability to directly contribute and share information with others via the Web; no central or hierarchical control structure exists (Vickery and Wunsch-Vincent 2007).

\textsuperscript{13} Refer www.tripadvisor.com and www.urbanspoon.com.
experiences regarding hotels and restaurants respectively, whereas Whirlpool\textsuperscript{14} provides an online platform for users to discuss topics and share experiences in the Internet and technological realm.

2.2.3.2 Blogging

Blogs – a blog is an abbreviation of the words ‘Web log’ – are a different form of social networking. Blogging, Anderson (2007) states, is about exchanging views. The owner of the blog writes short articles, opinion pieces or other information in posts, which subscribers to the blog can read and respond to, thus creating the opportunity for an online debate. Blogs are generally aimed at certain interest groups, focusing on a hobby, profession or other activity or interest. A form of micro-blogging has emerged in the form of Twitter\textsuperscript{15}. Twitter users send short messages of no more than 140 characters called ‘tweets’, to which other Twitter users can subscribe in order to follow a person’s stream of messages. Initially instigated as a form of communication that could answer the question ‘what are you doing?’, this was changed to ‘what’s happening?’ to replicate how people use the service (Twitter 2009).

2.2.3.3 Wikis

A wiki is a collaborative digital document that is generally text based (Vickery and Wunsch-Vincent 2007). These Web documents can be edited by anyone with access (Anderson 2007), including changing or removing content added by other contributors (Vickery and Wunsch-Vincent 2007). Wikis differ therefore from blogs, as subscribers to a blog can only comment on blog posts and not alter them. The most popular wiki is perhaps Wikipedia\textsuperscript{16}, the online encyclopaedia editable by anyone who wants to, keeping in line with the fundamental idea behind wikis, “…that a large number of users read and edit the content, potentially enriching it and correcting mistakes” (Vickery and Wunsch-Vincent 2007, p. 37).

2.2.3.4 Podcasts and RSS

Podcasts are digital media files that are made available for download via the Web (Warr 2008), to be played on portable music players or listened to via the Web at a time convenient to the user. Organisations such as radio broadcasters commonly provide podcasts of radio programs – the Australian Broadcasting Corporation (ABC) for

\textsuperscript{14} Refer forums.whirlpool.net.au.
\textsuperscript{15} Refer twitter.com.
\textsuperscript{16} Refer en.wikipedia.org/.
example offers a variety of podcasts of radio broadcasts that are downloadable via its website\textsuperscript{17}. Other organisations including universities and libraries have also increasingly “…found it useful to record audio presentations and make them available for download over the Web as podcasts” (McDermott 2007, p. 37).

Another common Web 2.0 application is RSS, Really Simple Syndication or Rich Site Summary. RSS is a means to keep track of changes to content (updates) on favourite websites or blogs (Anderson 2007). Provided a site is RSS enabled, users can subscribe to the RSS feeds of sites to subsequently receive notifications when the content changes.

2.2.3.5 Social bookmarking sites

Social bookmarking sites are a means to store (bookmark) useful websites, with Delicious\textsuperscript{18} an example of one of the better known ones. The advantage of using a bookmarking site rather than keeping bookmarks in a browser is that a) they can be accessed from any computer, and b) the incorporation of tags makes it possible to find other people’s bookmarks with the same tags (Funk 2009). This not only assists in finding other useful sites and references (McDermott 2007), online tagging also creates online communities (Krasne 2005). CiteULike\textsuperscript{19} is an example of a social bookmarking site of a more academic nature as only academic papers can be stored, but the same principles apply.

2.2.3.6 Tagging and mashups

Tagging is the process of attaching descriptive keywords to digital data (Anderson 2007), such as to photos, blogs and videos. Tagging is a key feature of many Web 2.0 applications including blogs, multimedia sharing and social bookmarking sites. It is also growing in use by other Web organisations (Sinclair and Cardew-Hall 2008) such as news and information websites, whereas the Mozilla Firefox browser allows people to add keywords to Web pages saved as favourites. Tags in turn can be visualised using tag clouds – a graphical display of the tags used on a particular site. In a tag cloud, the bolder and bigger the tag, the more often it is used (Anderson 2007). Figure 2.1 shows the tags used on the Australian ABC’s news website on a particular day.

\textsuperscript{17} Refer www.abc.net.au/services/podcasting/.
\textsuperscript{18} Refer delicious.com.
\textsuperscript{19} Refer www.citeulike.org.
Geotagging differentiates from tagging in that it attaches geographic information or metadata (Luo et al. 2008) to digital content, and thus provides a geographic reference turning it into geographic information (see the later section 2.4). Geotagging can be achieved through visible textual tags as found on Flickr or the ABC website, or using coordinates found in metadata. Images taken with GPS enabled cameras have such metadata attached and if uploaded onto a photo-sharing site like Flickr, these geographic coordinates can show where the picture was taken.

An important aspect of tagging and geotagging is the informality of the process. People use tags that are personal and have meaning to them, which combined form “…an informal classification of information” (Lackie and Terrio 2007, p. 13). This, in the context of online tagging is referred to as folksonomy (Anderson 2007; Lackie and Terrio 2007; Sinclair and Cardew-Hall 2008). A quick look on Flickr for example, reveals that photos about Wilsons Promontory National Park (WPNP) are tagged with a variety of keywords that include ‘wilsonprom’, ‘wilsons’, ‘prom’ and
‘wilsonpromssqueekybeach’\textsuperscript{20}, but also ‘beach’, ‘sunset’ and ‘blue’. The personalisation of tags has the advantage that it creates user value (Krasne 2005; Shirky 2006); it is in essence UCI that gives organisations personal information about the user. Kroski (2006) views the folksonomy created by user tagging an example of collective intelligence, which offers insight into users’ behaviour.

Apart from tagging, another popular Web 2.0 feature that has emerged are so-called mashups (Butler 2006). Mashups combine data or functionality from different sources to create a new service (Warr 2008). Merrill (2006) agrees, expanding on the concept of mashups as being interactive Web applications that pull together content from other websites. When one of those sources is a mapping service such as Google Maps or Bing Maps, the result is a map mashup. These map mashups have the benefit of being able to provide users with a geographical location as well as other relevant information. A wide range of information is displayed using map mashups including hotel and restaurant search results on Google or real estate listings\textsuperscript{21}.

2.2.3.7 Social media usage in Australia

The number of people that are using social media is growing, and is continuing to do so. Social media usage in Australia, according to a Nielsen survey in early 2010, was estimated to be at around 9.9 million, whereas the number of unique Facebook users for around that time was 8.6 million (Sperti 2010), compared to 13 million in November 2011 (Cowling 2011). Statistics for November 2011 of a monthly review of social media usage in Australia published by SocialMediaNews\textsuperscript{22} are shown in Table 2.1 (the figures showing are the number of unique visitors per month).

Social networking sites, multimedia sharing sites and blogging applications therefore dominate social media usage in Australia, with the top 10 all following in one of these categories. A rise in the adoption of Web 2.0 is also occurring in the organisational realm, which is described in more detail in Chapter 3.5.

\textsuperscript{20} Squeeky Beach is a particular beach located in WPNP.
\textsuperscript{21} Refer www.realestate.com.au for an example.
\textsuperscript{22} Refer socialmedianews.com.au.
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<table>
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<td>1. <em>Facebook</em></td>
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<td>2. <em>YouTube</em></td>
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<td>3. Blogspot</td>
<td>3.8 million</td>
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<td>4. <em>LinkedIn</em></td>
<td>2 million</td>
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<td>5. <em>Twitter</em></td>
<td>1.8 million</td>
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<td>6. WordPress.com</td>
<td>1.6 million</td>
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<td>7. <em>Flickr</em></td>
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<td>8. <em>Tumblr</em></td>
<td>1 million</td>
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<td>9. <em>MySpace</em></td>
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<td>10. <em>Google Plus</em></td>
<td>540,000 users (not unique visitors per month)</td>
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Table 2.1 - Social media usage in Australia for November 2011.

### 2.3 New media, communication and social networks

New media is often distinguished from other media in either technological or social terms (Lievrouw and Livingstone 2006). Rice (cited in Lievrouw and Livingstone 2006) identifies differences in technological features and states that new media generally involves computer technologies for the purpose of user interaction either with each other or with information. It is the digital aspect, in part, that makes new media ‘new’, with a shift in storage, delivery and access of information from analogue to digital (Flew 2005). According to Lievrouw (2006), the social aspect relating to technology, or the ‘social shaping of technology’ is more about how people use technology, how it is adopted into society, and ultimately what choices people make. Jenkins (2008) points out that new media does not replace older ones, but rather that a shift occurs resulting in old media subsequently being used for different purposes. New media encourages other media to change and adapt (Flew 2005) and the application of Web enabled mobile devices and electronic books (e-books) is perhaps witness to that. Flew (2005) states that new media is commonly associated with the Internet but Lievrouw and Livingstone (2006) perceive the current new media to be technology that provides users with the ability to access information, modify it and share it – in other words Web 2.0 or the New Web. And if the current new media is about user interaction, it is also linked to what is commonly known as social media, confirming that Web 2.0 is the Social Web.
2.3.1 Communication technologies and the Information Age

The invention of the telegraph in the 19th century was perhaps the first step in the process of electronic communication technologies, followed by subsequent developments in the 20th and 21st centuries. Going back to the 1950s, Hirst and Harrison (2007) identify the radio, television, videotape, personal computers, satellite TV, laser-read CDs and DVDs as key digital communication technologies, finishing with the wireless and broadband applications of today’s era. The ubiquity of computing on a vast array of Web enabled devices and the cross platform communication that takes place is part of today’s new media information revolution and democratisation of knowledge.

With the arrival of the telegraph, according to some, the Information Age commenced. For the first time, there was a difference between the delivery of the speed of information and the speed of humans – information moved faster than humans could. Computers were subsequently regarded as the second phase of the Information Age, although others argue that it was the arrival of the Internet that initiated the Information Age (Brown and Duguid 2000). Arguably, the Internet has separated the variation in speeds even more, and additionally has allowed for the transfer of a much larger and diverse amount of information and on a global scale. The initial vision for the Web consisted of a “single, global information space” (Berners-Lee and Fischetti 2000, p. 4), the linking of all the information that is stored on computers. With the arrival of the Internet and its role as communications infrastructure, this idea of connecting computers globally could be materialised (Berners-Lee and Fischetti 2000).

2.3.2 Changed communication and social networks

An apparent outcome of today’s new media is the reduced distinction between the role of producers and consumers of information (Jenkins 2008). With social media, users are both producers and distributors (Gillmor 2006; Shirky 2008) or readers and writers (Kamel Boulos and Wheeler 2007). Similarly, the social aspect of the new media has affected communication and particularly group communication (Shirky 2008).

Traditionally, the general broadcast media such as television and newspapers was a one-way communication with one message distributed to many people (the viewers). Communication technology on the other hand was a two-way conversation that was generally between two people who exchanged messages between each other (like a telephone or telegraph). What new media and particularly the Web 2.0 tools have made possible is for communication to become a group exercise, with “Web-enabled
communities” (Tapscott and Williams 2008, p. 3) sending many messages, sent by many people to many people. As a result, the distinction between broadcast and communication has somewhat diminished (Shirky 2008), as all Web users are now active participants in creating and distributing information with the users becoming the media (Gillmor 2006). These “new dynamic, networked forms of communication” (Tapscott and Williams 2008, p. 263) are also found in the work environment. Employees are starting to use wikis, blogs and other types of collaborative tools resulting in the impromptu forming of communities across organisational divisions (Tapscott and Williams 2008).

The participatory nature of Web 2.0 has created social networks, the increased group interaction that Shirky (2008) describes. At an individual level, friends socialise and share information on social networking sites like MySpace or Facebook, or videos and photos on YouTube or Flickr. These friends can be ‘real’ friends - people they know in real life - or peers or like-minded ‘virtual’ friends. Social networks are also being formed through applications like blogs, Twitter and wikis. Users of a particular blog become a network of like-minded people that share a hobby, profession or other interest. These blog participants are able to exchange information and discuss ideas, in return increasing everyone’s knowledge. Many such social networks are formed spontaneously (Surowiecki 2005) and are the result of individual people’s interest. People are making their use of the Web and communication tools personal to give it greater meaning.

The new social communication tools, Shirky (2008) argues, are not always an enhancement, but they should be seen as a challenge instead. It is up to society as a whole to adapt, reject, modify or accept them. As McLuhan (1964) states, it is what people do with new technology that matters, not what the technology itself can do. The social acceptance of technology as described by Lievrouw (2006) has seemingly been positive in the case of the emerging Web 2.0 technology. It has been adapted and is being utilised by people at different levels and for their own purpose. According to statistics, 62% of Australians who use the Internet, use one or more social media tools mostly on at least a daily or weekly basis (Sensis 2011). People are choosing to participate in different ways and on different levels to suit their personal needs or ability (Jenkins 2008), adapting the technology bestowed upon them for personal gain.
2.3.3 Adoption into society

Web 2.0 has allowed for information to be created, captured and distributed in new ways. The way people communicate has changed, which, according to Shirky (2008) should subsequently change society. This is arguably observable in the increased use of social media in disaster situations by both the public as well as official authorities. For instance, social media tools were employed for communication purposes during the bombing attacks in Mumbai, India in 2008, the 2010 Haiti earthquake and the 2010-11 floods in Queensland, Australia. As a result of the latter, Queensland researchers received federal funding to analyse the impact of social media on such situations (Senator the Hon Kim Carr 2011). Similarly, the Emergency 2.0 Wiki\(^23\) was launched in December 2011 to assist emergency managers worldwide in using social media and technologies in emergencies. And in the State of Victoria, Australia, three recommendations made following the review into the emergency response to the 2010-11 Victorian floods consider the use of social media to communicate with the public (Comrie 2011). Recommendation 42 particularly states that “the state [of Victoria] undertake further trials to explore the opportunity for greater use of social media as a credible source of information to and from the public during an emergency” (Comrie 2011, p. 7). Within a few years of its arrival therefore, the new media appears to have been accepted and is being utilised to suit people’s needs. Information is being democratised (Hirst and Harrison 2007), not just in its availability but also how it is being created in the first place, how it is distributed, delivered and received.

2.3.4 Collaboration and Collective Intelligence

Web 2.0 is about user participation (O'Reilly 2005) and users participate by not only contributing content, but also by communicating that to others. Collaboration “…involves the most grassroots and collegial side of the Web community” (Berners-Lee and Fischetti 2000, p. 171), highlighting the social aspect of the New Web. Tapscott and Williams (2008) believe that collaboration between masses of people can have positive results for many sectors of society including arts, science, education and the government. It is the collectiveness of the action that makes this happen. Furthermore, the social networks that are being formed through collaboration “… allow people to connect and coordinate with each other without a single person being in charge” (Surowiecki 2005, p. 70), which reveals the inherent decentralisation of collaborative systems within the realm of Web 2.0. Information is distributed, shared

and re-used almost voluntarily revealing a bottom-up hierarchy, or at least a horizontal structure, instead of the more commonplace top-down or vertical approach in existence in many organisational structures. Collaboration from this perspective allows organisations to pool the individual bits of information and utilise them in an aggregated way. Surowiecki (2005, e.g. p. 70) identifies “the wisdom of crowds”; individuals don’t know everything, but when combining their knowledge, their collective intelligence may well prove to provide better answers than those of individual experts. The essence of a wiki as outlined by Vickery and Wunsch-Vincent (2007, p. 37) that “…a large number of users read and edit the content, potentially enriching it and correcting mistakes” confirms just that. The positive results of group action will also generally overshadow the negative ones (Shirky 2008).

An advantage of collaboration is that it can give participants a greater voice, or in effect more power (Jenkins 2008). For example, YouTube can be classed as a central point for different media activities, where different media users and media types converge into a so-called “shared media portal” (Jenkins 2008, p. 274). Arguably, individuals or small groups of people are more easily ignored than a large organisation. The advantage of a shared system that results in greater visibility further produces advantages in relation to sharing technologies, and discovering new developments and opportunities (Jenkins 2008).

2.3.5 Capturing collective intelligence

Web 2.0 companies should exploit the collective intelligence that is being created as a result of users’ participation and interaction, according to O’Reilly (2005). This new way information is being generated and disseminated through collaboration (Vickery and Wunsch-Vincent 2007) creates opportunities to gather external information (Tapscott and Williams 2008). It provides economic, organisational and other benefits (Surowiecki 2005) and can arguably enhance existing information (O'Reilly 2005; Vickery and Wunsch-Vincent 2007) or be applied for knowledge creation and decision-making (Cartwright 2009). A key Web 2.0 principle identified by O’Reilly (2004) is that the more users are involved (collaborating), the greater the service will become. This should also benefit in the case of the collective intelligence being gathered because as Surowiecki (2005) suggests, group wisdom is generally more effective or ‘wiser’ if the group is bigger. This is because the group has a greater chance of containing diversity, important for good group decision-making. Shirky (2008) concurs, adding
that the emerging technologies have made it easier for many individuals possessing various skills to participate effectively as a group. From a Web 2.0 perspective, the more users contribute, the better the resulting knowledge.

The premise that UCI can potentially benefit existing information is one of the fundamental theories of this research project. Instead of merely relying on Parks Victoria’s own organisational data and data from reliable experts, the GKT also draws on alternative data sources that include UCI and it was assessed whether these non-traditional data sources can potentially complement the existing data archive.

UCI can be gathered actively or passively (Girardin et al. 2008; Turner and Forrest 2008). Users voluntarily add information to websites – they contribute to blogs and add photos to photo-sharing sites for instance. Passive data collection also takes place without the users necessarily knowing that information is being gathered (Hardey 2007). Special technologies and algorithms are in place to capture this such as keywords entered in a search engine, tags accompanying photos, or personal details when completing a registration form. Privacy issues aside, this type of information can enhance the service provided and can be (or rather ‘is being’) utilised for commercial purposes (Anderson 2007). For example, the information provided by users on the online bookstore Amazon\(^{24}\) is utilised to create a popularity list. Amazon lets buyers create book ratings, which subsequently translates into a bestselling or popularity rating, assisting other buyers in making (informed) choices (O'Reilly 2004) and raising sales.

The term ‘crowdsourcing’ (Howe 2006) has emerged to describe how the collective intelligence of people can be harnessed. Crowdsourcing refers to the outsourcing of a project to a group of people, generally large in numbers. These people are not centrally organised and collectively create or contribute data to complete a project or task (Hudson-Smith et al. 2009a). Web 2.0 is helping crowdsourcing by providing the tools that people anywhere can use to contribute to the project. The key to crowdsourcing, according to Hudson-Smith et al. (2009a), is recognising the value that potential users possess and can contribute. Crowdsourcing arguably draws on Surowiecki’s ‘wisdom of the crowds’ principle, but as Howe (2008, para. 2) points out, the crowd is not just smart, it is also “talented, creative and, stunningly productive”.

\(^{24}\) Refer www.amazon.com.
Despite the principles that underlie Web 2.0 organisations, Jenkins (2008) illustrates that the collective intelligence user participation provides, is sometimes overridden for, for instance, commercial reasons. This has, arguably, been demonstrated by Amazon when it was alleged that the company removed ratings from certain books the company deemed unsuitable to appear on popularity list (although Amazon has denied this was deliberate) (Johnson and Pidd 2009). It is possible that this organisational authority could be the professional editing some have argued is needed (Carr 2006; Shirky 2008) (although in Amazon’s case, this argument would not have applied). But perhaps all companies (websites) need at least a minimum level of organisational structure and management, as no structure at all can create chaos (Jenkins 2008). Or as Shirky (2008, p. 19) points out: “if you want to organise the work of even dozens of individuals, you have to manage them”. This minimum level of management is perhaps provided by the moderators of a site, who can check if UCI is appropriate and abides by the participation rules and conditions for example.

2.3.6 Projects that capture the collective intelligence

Organisations like Amazon, eBay and Wikipedia use crowdsourcing principles. They rely on users to participate to make their sites work. And the more people contribute and participate, the better the quality of UCI and resulting collective intelligence. These notions of collaboration, collective intelligence and crowdsourcing have also been utilised, and still are, in a range of special projects and for different reasons. In all instances, the project organisers recognise the potentially valuable information individuals may possess and can contribute.

For example, the Library of Congress in the United States released over 3000 photographs on the photo-sharing site Flickr under the Commons Project. It encouraged viewers to attach information to the photographs in the form of tags – thus capturing informative keywords relating to the photographs. The ultimate aim of the project was finding previously unknown details (Raymond 2008), whilst the UCI should ultimately result in improved, or optimised metadata (Stvilia and Jörgensen 2009).

In the scientific world, the public were asked to participate in the Galaxy Zoo project (Galaxyzoo.org 2007), a collaboration between an English and an American university.

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Being in possession of a vast number of imagery of galaxies obtained via the Sloan Digital Sky Survey but lacking the manpower to analyse the pictures for classification purposes, they asked the assistance of the public. Apart from the millions of galaxies classified, hundreds of new galaxies as well as a mysterious new object\(^{26}\) were discovered as a result (University of Oxford 2008). Similarly, Novartis, a Swiss drug maker, made raw data on type 2 diabetes freely available on the Internet in 2007 because they lacked the manpower to investigate this due to the numeric possibilities that existed (Tapscott and Williams 2008).

In the natural environment realm, the eBird project, by the American Cornell Lab of Ornithology and National Audubon Society and launched in 2002, asks both amateur and professional bird enthusiasts to record their bird sightings onto a central database, resulting in a worldwide, vast data resource on birds and biodiversity that is continually growing (eBird n.d.). In Australia, the RabbitScan project involves the public to map occurrences and impacts of rabbits on their property in their area (FeralScan 2011). The combined individual contributions produced a nationwide picture of the location of rabbits and their impact on the environment.

Some project examples have arguably emerged from a necessity, that is, the organisations behind them were not able to cope with the demand and lacked resources. All, however, to varying degrees and whether out of necessity or not, recognise that the public (that is non-traditional data contributors) may be of assistance and that technology is in place to facilitate this. The Commons Project between the Library of Congress and Flickr explicitly recognises the knowledge that the public, that is the viewers and users of the site, may actually hold and they are actively seeking to gather that information. eBird and RabbitScan organisers similarly aim to capture the local knowledge that people possess, the individual bits of information they can contribute to collectively produce a larger solution.

\section*{2.4 Where 2.0}

An increasing amount of data on the Web is geographic in nature (Crampton 2009; Dykes and Mountain 2003). The terms ‘Geospatial Web’ or ‘GeoWeb’ are used to indicate this vast and growing amount of digital, georeferenced information (Crampton

\(^{26}\) The mysterious object found has been named ‘Hanny’s Voorwerp’, after the Dutch teacher who discovered it (University of Oxford 2008)
2009), or what O’Reilly (cited in Turner and Forrest 2008) refers to as ‘Where 2.0’. Where 2.0 defines the geographic or locational aspect inherent in many Web 2.0 applications and UCI – so called ‘volunteered geographic information’ (Goodchild 2007), ‘collaboratively contributed geographic information’ (Bishr and Mantelas 2008) and ‘user generated geo-content’ (Das and Kraak 2011).

Location technologies are a core aspect of the New Web (Gordon 2007) and mobile devices in particular are increasingly about location. It is not just being able to access the Internet through wireless connections, but GPS enabled mobile devices such as mobile phones and cameras increasingly generate user information that is instantly georeferenced (Turner and Forrest 2008). The emergence of mapping tools and technologies including geospatial platforms like Google Earth and Google Maps that are freely available via the Web means that people can easily visualise and create georeferenced information. Cartographic opportunities are found in crowdsourcing, Open Source (see section 2.5.3) and many other applications and tools (Crampton 2009). According to Abrams and Hall (2006, p. 16), maps have “…emerged in the information age as a means to make the complex accessible…, mapping has become a way of making sense of things”. The myriad of map mashups being created perhaps testify to that. And in line with the participatory nature of Web 2, not just people with cartographic knowledge but also amateur mappers are busy producing them (Hudson-Smith et al. 2009b). Many of these maps are cognitive and personalised, and help users interact and make sense of what the Web has to offer (Gordon 2007).

The aforementioned eBird and RabbitScan projects are examples of projects in the geospatial realm that ask contributors to contribute geographic information and in effect create a collectively produced map mashup. Data are sourced from individual contributors and visualised on a map base using Web enabled mapping tools. The proposed GKT in part uses the geographic attributes of data to make it findable; hence, the UCI that the tool incorporates needs to also be geographic.

Geographic information on the Web and associated issues are discussed in more detail in Chapter 3.6.1.
2.5 Issues associated with Web 2.0

There are varying views on Web 2.0 and how it may be or is affecting different aspects of society, information and communication. There is general agreement however, that a number of issues associated with Web 2.0 exist (e.g. Keen 2007; McDermott 2007; Shirky 2008) and need to be considered, although Warr (2008) states that not all are specific to the technology – spam, for example, comes by fax and through the mailbox as well. Issues identified as key considerations would become part of the conceptual model of the GKT, and their existence would need acknowledgement at a minimum and addressed where possible if the hypothetical GKT was actually built. The final section of this chapter discusses some of these issues in more detail.

2.5.1 Quality of UCI

It has been argued that the amount of information available as a result of computers, the Internet and the Web is by some regarded as too much (Brown and Duguid 2000). With the arrival of Web 2.0 and subsequent increase of UCI, the amount of available information is not only greater, an immeasurable amount is of poor quality (Keen 2007; McDermott 2007; Shirky 2008). This is because there is no system in place to filter “good from mediocre” (Shirky 2008, p. 81), where ‘amateur rubbish’ exists next to quality information. According to Carr (2006), a real-life editor can improve websites’ content versus those relying on software algorithms. However, many Web applications do not filter or edit their content, and leave the control in essence with users. Wikipedia is an oft-quoted example of UCI of questionable quality (Anthony, Smith and Williamson 2007). Research indicates nonetheless that the quality of the site’s information is no better or worse than Encyclopaedia Britannica, and it is argued that it is much easier and quicker to correct errors in Wikipedia than in its paper or professionally edited equivalents (Giles 2005). Additionally, projects like Wikipedia and the collaborative mapping project OpenStreetMap27 (OSM) ensure the quality of the data contributed by their users is sufficiently accurate for the system to work – the former through a community of ‘Wikepedian’ administrators (Weinberger 2007) and the latter by providing guidelines and standards to which data collectors must adhere (Hudson-Smith et al. 2009a).

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27 Refer www.openstreetmap.org.
To diminish one argument of the debate on the quality of UCI somewhat, it is perhaps necessary to view the content from the intended audience’s perspective. According to Shirky (2008), information put on the Web, although accessible to everyone, still has a specific target audience. So, if users disagree with the usefulness or relevance of certain content, they are probably not the anticipated audience. A group of teenage friends on Facebook may use the site for their everyday conversations, not necessarily quality material in the view of others, whereas some of the messages on Twitter may similarly be the equivalent of having a simple conversation with a friend on a train.

However, a distinction also needs to be made between information that is of poor quality or merely silly, and content that is downright incorrect. If incorrect information is passed on as fact, it could cause embarrassment or diminish reputations at a minimum, or could result in serious consequences. Inaccurate geographic information from a park management perspective, for example, could result in the planned burning of an area of a park that houses sensitive fauna species or slashing a rare orchid during weeding activities because they were thought to be located somewhere else. This is arguably where the quality control or professional editing, or lack thereof, described by Keen (2007) and others, gains validity.

The research project developed a theoretical methodology for a confidence rating system in an attempt to address the quality issue associated with UCI. This is described in detail in Chapter 5.6.3.

### 2.5.2 Privacy

Privacy is a key issue associated with Web 2.0 and UCI (Vickery and Wunsch-Vincent 2007; Warr 2008), with a blurring of the line between private and public and the associated loss of privacy a downside to the new social media (Shirky 2008). This has arguably started with the arrival and subsequent rise of mobile phone usage. Where conversations used to be clearly private when conducted on the home phone, these conversations are now conducted in the public sphere using mobile devices. But Web 2.0 tools such as blogs and feedback forums are designed to voice one’s opinion in public. Conversations previously held with friends in the privacy of home or work place are now in the public realm for everyone to read (and respond to). Additionally, Cartwright (2007) argues that the issue of privacy has deepened due to mobile Internet enabled devices. People’s “locational privacy” (Monmonier 2005, p. 98) diminishes when they access georeferenced information or require location based services that rely
on “…knowing where users are at any given time, their movement history and their activities linked to them being at a certain location” (Cartwright 2007, p. 456).

It can be argued that there is something positive about the diminishing of privacy – possibly when putting this in the context of ‘secrecy’ or ‘freedom of information’ we may seek from our governments. Furthermore, a reduced need to protect personal privacy in younger generations has specifically been identified as a social factor in the increased online participation and content creation (Vickery and Wunsch-Vincent 2007). However, there is a clear downside to the issue and care needs to be taken when contributing information. The US Department of Defense is actively using social media communication tools, and one of its news articles list a number of best practices to be aware of, to ensure a safe online experience (American Forces Press Service 2010). In Victoria, the Office of the Victorian Privacy Commissioner (2009) also warns about this loss of privacy when putting personal information on social networks sites. Even if the content is meant for friends only, it can still be passed on to others and remain in the public realm for years to come. Although the warning is aimed at the younger generation, the message should apply to all those who upload. What is posted by individuals is out there for everyone to see and use with limited control, if any, by the original content creator. Also in Australia, the ABC’s Privacy Policy regarding online interaction with the site perhaps explains it most clearly:

...whenever you post personal information in publicly accessible places, such as chat rooms or message boards, this information becomes available to anyone with access to the internet. This information can be collected and used by others… Therefore, we recommend that you refrain from posting any information that you do not want seen in these public areas... Ultimately, you are solely responsible for maintaining the secrecy of … any personal information. Be responsible whenever you are online (ABC 2011, Para. Interacting with ABC Online).

Survey results conducted as part of Privacy Awareness Week indicate that people are very aware of such issues. More than 80% understood the privacy settings of the application they used, and had changed those settings, whereas over 90% of people shared information with people they knew only, or else shared different information with different people (Asia Pacific Privacy Authorities 2011). But even if users try to
protect their privacy to the best of their ability, others may still interfere. Both Facebook and Google\(^{28}\) for example, have been in the news in recent years for privacy breaches. As a result, the State of California introduced the Social Networking Privacy Act\(^{29}\) into the Senate, which, although rejected twice (Satterfield 2011) thus far, could lead to new or changes to existing legislation in the future, specifically aimed at these privacy and security issues. In Europe, the European Union has announced it will make online privacy and data protection stricter\(^{30}\), and that those rules should now also apply to foreign companies that have European customers such as Facebook and other major social media sites (O'Brien 2011). Similarly, the current Privacy Act in Australia only applies to organisations based in Australia (there appear not to be any proposed changes to that rule similar to the European one). The Australian Government provides guidelines and information on how citizens’ privacy is protected under the Privacy Act\(^{31}\). In Victoria, the Information Privacy Act 2000 (Vic) applies to public sector employees dealing with the private information of citizens\(^{32}\) acquired online, whereas the Victorian Department of Justice has released its own Social Media Policy\(^{33}\) for dealing with the public. If social media and the participatory Web are staying, which most agree is the case (Vickery and Wunsch-Vincent 2007; Warr 2008), it is imminent that appropriate legislation will be developed to protect the online privacy and security of all parties. This process has started already and will no doubt continue.

\subsection*{2.5.3 Copyright and Open Source}

Another issue associated with UCI is the ownership of the information, the copyright or intellectual property right in some instances. Who owns the original data is perhaps the most easily established, but what happens with that ownership once the original UCI is being shared, altered and reused for other purposes? This has in part been dealt with by the introduction of appropriate licencing systems that have seen an increase in UCI, because it can now be more easily created, shared and reused (Vickery and Wunsch-Vincent 2007). Issues relating to copyright, intellectual property and data ownership are

\footnotesize

29 This is California Senate Bill SB242. See info.sen.ca.gov/pub/11-12/bill/sen/sb_0201-0250/sb_242_bill_20110502_amended_sen_v98.html for the amended version.
33 Refer www.justice.vic.gov.au/home/about+us/our+values+and+behaviours/social+media+policy/.
more easily addressed using these licensing systems. Two key systems in place are the Creative Commons licenses\(^{34}\) that cover all types of digital content, and the GNU General Public License\(^{35}\) that is particularly for the licensing of free, Open Source (OS) software. Key differences between the various Creative Commons licenses are stipulations with regards to commercial uses, and crediting of the original creator after it has been shared, altered and reused (Creative Commons Australia 2011). Not all information is therefore freely available and may carry copyright or access restrictions instead. Many photographs on Flickr for example have a license attached that stipulates if the image can be used ‘as is’, if it can be reused and what the conditions are for doing either. Flickr itself, under the Yahoo! Terms of Service that it is governed by, states that the company does not claim any ownership of any information being contributed to the site. However, it does reserve the right “… to use, distribute, reproduce, modify, adapt, publicly perform and publicly display such Content on the Yahoo! Services solely for the purpose for which such Content was submitted or made available” (Yahoo! Inc. 2012, para. 9b).

Apart from the legal sharing of UCI through appropriate licencing systems, there is also the issue of illegally sharing copyrighted content such as movies and music through social media sharing sites. The content contributed by users is arguably not ‘true’ UCI as it has not been provided by its legitimate owners for the purpose of sharing with others and is pirated UCI instead. Draft legislation\(^{36}\) is currently (as at January 2012) in the US House of Representatives and Senate in an attempt to address the issue of pirated UCI sharing. Although much controversy exists as to whether the proposed laws in their current state are adequate and appropriate, most agree that the issue needs to be addressed (AFP 2012; The Guardian 2011).

OS software and the notion of ‘copyleft’ are other means to address the copyright issue as well as any access restrictions. Copyleft refers to making programs and other work freely available, and ensuring that any subsequent versions modified by others remain free (rather than become restricted and commercial products for example) (GNU

\(^{34}\) Refer www.creativecommons.org.
\(^{35}\) Refer www.gnu.org/licenses/gpl.html.
\(^{36}\) The Stop Online Piracy Act or House Bill 3261 was submitted to the US House of Representative – see thomas.loc.gov/cgi-bin/bdquery/z?d112:h.r.3261:.
The PROTECT IP Act (Preventing Real Online Threats to Economic Creativity and Theft of Intellectual Property) or Senate Bill 968 was submitted to the US Senate – see thomas.loc.gov/cgi-bin/bdquery/z?d112:SN00968:.
Operating System 2011). OS software “is software that is made freely available to all...[by] Internet-based communities of software developers who voluntarily collaborate to develop software that they or their organizations need” (Von Hippel and Von Krogh 2003, p. 209). OS software is increasingly available to anyone, often for free, and lies at the heart of many Web 2.0 applications. The essence of OS is in line with Web 2.0, as OS software is created and improved collaboratively by its users (Hardey 2007). The growth of the OS movement means that people can now increasingly participate through the use of free tools that they in turn can help to create or improve (Anthony, Smith and Williamson 2007). According to Tapscott and Williams (2008), there has been a demand by users for OS, simply because of the restrictions associated with licensed software such as compatibility and cost. It must be noted that OS software has been applied from the beginning of the Web and, for example, the Web code used to create Web pages – the source code – has always been available to users (Berners-Lee and Fischetti 2000).

According to Anthony, Smith and Williamson (2007), there is a ‘social movement for public goods’ as observed in OS software. Coast (cited in Johnson 2009), the founder of OSM, similarly has no doubt that the focus will shift to collaborative projects that are free and open for anyone to use and contribute to. Linux, an OS operating system, is probably one of the better known examples of OS software whereas Mozilla’s Firefox Web browser is a well-known OS competitor against Microsoft’s Internet Explorer and Apple’s Safari browsers. Apache’s OpenOffice.org is an OS alternative to Microsoft’s Office suite and others, whilst Quantum GIS, or QGIS, is an OS GIS application. To get an idea of the wide range of OS software available, Wikipedia has a page dedicated to available OS software packages divided into about 20 categories.²

2.5.4 Other issues
There are a number of other issues associated with Web 2.0. The existence of a Participation Divide, as suggested by Hargittai and Walejko (2008) was already briefly mentioned in section 2.2.2. Linked to this and the also aforementioned Digital Divide are the issues of equity and accessibility. These are about equality of access and access opportunities, and maximising people’s ability to use the tools as already encapsulated in the Digital Divide. Being a Victorian Government agency, any hypothetical GKT built by Parks Victoria should follow any legislative requirements and guidelines as

³Refer en.wikipedia.org/wiki/List_of_free_and_open_source_software_packages.
outlined by the Victorian Government concerning accessibility, privacy and copyright, as well as any guidelines and principles regarding good Web design and usability. The eGovernment Resource Centre for instance\textsuperscript{38}, has a suite of website guidelines to help government agencies. Some of these may, or should, also apply to the GKT and would need to be taken into consideration should a GKT ever be built.

Another issue identified and regarded to be relevant to the research project relates to the variation in georeferencing of UCI. People are using informal terms as well as formal names, different methods and formats – in-text, textual geotags and geographic coordinates for example – and there is a variation in accuracy and precision of geographic attributes in general. Because the GKT uses geographic attributes to access data, these georeferencing variations need to be acknowledged and addressed if possible. Similar to the confidence rating system developed to address the UCI quality issue, the research project also developed a theoretical solution in an attempt to address the variation in georeferencing that exists. This is discussed in detail in Chapter 5.6.4.

Developing solutions for the majority of these issues was regarded to be outside the scope of the research project. They were discussed here to point out that there are both positive and negative aspects associated with Web 2.0. By including these in the conceptual model of the GKT (see Chapter 5.6), the research project acknowledged that the issues need to be considered at least, and addressed where possible and appropriate. Two key issues associated with the GKT, or the research project at large, were the quality of UCI and the variation in georeferencing. The research project hence decided to provide theoretical solutions to address these.

\section*{2.6 Chapter summary}

The purpose of this chapter was to develop a theoretical foundation for considering Web 2.0. It aimed to explain what Web 2.0 was about, and how its participatory and collaborative notions have been applied to suit different purposes. It has been argued that the information contributed by participants of collaborative tools could potentially be beneficial, particularly when UCI from individuals is combined to produce a collective intelligence. The research project adapted this theory of UCI being potentially useful, and assessed if alternative data – UCI broadened in scope to include public data

repositories on the Web – could potentially complement an existing park management data archive.

The chapter commenced with a summary of Web 2.0 and explored why the Web changed to become the participatory Web it is at present. Key notions of user participation and UCI were discussed, whilst the main applications generally regarded to encompass Web 2.0 were described in more detail. These included social networking sites, blogging, wikis, podcasts and RSS, social bookmarking sites, and the tagging and mashup features. Statistics from 2011 showed that social media usage had grown in Australia, with social networking sites, multimedia sharing sites and blogs the most popular social media applications.

The next section explored aspects of new media and communication. It discussed how today’s new media – the social media tools of Web 2.0 – has changed communication processes and enabled social networks and ‘Web-enabled communities’, where groups of people communicate using collaborative Web tools. A few examples of recent events where social media applications were utilised to communicate were provided, to show the adoption of Web 2.0 into society. The section continued with a more in-depth discussion on the Web 2.0 notions of collaboration and collective intelligence, and explored why the latter should be captured. It briefly discussed crowdsourcing, before showing examples of projects that have indeed captured the collective intelligence of its participants. The Commons project, for instance, aimed to capture individual bits of knowledge to enhance an existing photograph collection, whilst RabbitScan was an example of a project that aimed to create a nationwide picture by combining individual contributions.

The geographical aspect of Web 2.0 was briefly explored in the next section, with the term Where 2.0 applied to highlight the geographic component inherent in many Web 2.0 applications and tools. With digital mobile devices that are increasingly location-aware, UCI can also be instantly georeferenced. Although generally regarded as positive, a number of issues associated with Web 2.0 existed. The final section summarised several key issues, including the quality of UCI, privacy, copyright and OS. It was concluded that these issues would need to be considered and addressed where appropriate, if a GKT was ever to be built.
For the research project, it was ultimately about the concept of Web 2.0 – the collaborative and participatory notions, UCI and the resulting collective intelligence. The proposed GKT aimed to utilise the UCI and collective intelligence that are being created by users of participatory tools and UCI already found on the Web, in digital data repositories made available by organisations and individuals – experts and amateurs alike. Web 2.0 had provided the conceptual foundation for this opportunity.

The next chapter, Knowledge and Knowledge Systems, discusses the basics of knowledge, and provides an overview of aspects of different knowledge systems to finish with opportunities for a collaborative, geographically oriented knowledge system that recent Web developments have made possible. The purpose of the chapter is to further provide a theoretical foundation for the proposed GKT – in essence a collaborative (considering Web 2.0 principles), geo-oriented (considering geospatial Web developments to access georeferenced information) knowledge system (tool).
Chapter 3. Knowledge and Knowledge Systems
3.1 Chapter overview

The Information Age has seen an increase in available information (Brown and Duguid 2000; Dykes and Mountain 2003) as a result of the application of computers and particularly the Internet and World Wide Web. This has increased further with the arrival of Web 2.0 and associated UCI, with information being provided by both traditional and non-traditional contributors and made available via the Web and mobile devices. The questions to be asked are what can be done with this information - how can it be used effectively, how to make sense of it, and can it be turned into knowledge.

Similar questions lay at the core of the research project. Its primary objectives were to make better use of an existing data archive and explore if alternative information sources available via the Web could complement the existing data. Could both be used more effectively, and could the latter complement the former by filling information gaps or reinforce existing knowledge perhaps? The research proposed a methodology for a GKT to achieve this – regarded to be a digital information or knowledge system that would, in part, use geographic attributes to make relevant data or information more easily accessible or findable. The purpose of this chapter is to provide a theoretical foundation for the proposed GKT by discussing core issues relating to knowledge and knowledge systems, and discussing the geographic perspective – associated with the tool and data’s geographic attributes.

The chapter firstly discusses the fundamentals of knowledge including the transformation from data to knowledge, and how knowledge may be captured. This at times has an organisational perspective, to put it in the context of Parks Victoria and its organisational information issues. It then moves to so-called synthetic knowledge systems, describing methods for organising information and knowledge. It discusses the importance of classification as a tool for information retrieval, as well as hypertext and geographically oriented knowledge systems with a brief overview of basic applications. The next section focuses on the Web as a knowledge system, and how information is stored and linked on the Web, before moving on to the collaborative and participatory notions of Web 2.0 experienced in knowledge management and knowledge sharing – referred to as Enterprise 2.0 (McAfee 2006). The ‘geo’ element is added to knowledge systems in the ensuing section with a discussion on Web developments in the geospatial realm, focussing on geographic information, visualisation of this information and maps,
and the use of map metaphors to visualise non-geographic information. The chapter concludes with examples of projects and applications that apply geographic visualisation methods and crowdsourcing to present information and knowledge.

### 3.2 The fundamentals of knowledge

The data-information-knowledge-wisdom (DIKW) model, also known as the knowledge hierarchy or knowledge pyramid (see Figure 3.1), is a widely accepted representative of the hierarchy in the context of information and knowledge (Rowley 2007).

![DIKW model or knowledge pyramid.](Source: Rowley 2007, p. 164)

Depicted in a pyramid, data lie at the bottom and wisdom is the uppermost layer, and each higher layer incorporates those below (Ackoff 1989). Data, according to Ackoff (1989), are mere symbols; representations of objects and events that are unusable until put in context and made relevant. Chaffey and Wood (cited in Rowley 2007) more or less concur, applying the term ‘meaning’ to differentiate between different stages. Data are unorganised, discrete facts and observations that are meaningless, whereas information is data that have been processed and organised so as to “have meaning and value to the recipient” (Rowley 2007, p. 171). Ackoff (1989) defines information as giving answers to the questions: ‘who?’, ‘what?’, ‘where?’ and ‘when?’; whilst knowledge answers ‘how?’. Finally, he regards wisdom as an ‘evaluated understanding’ that requires the mental ability to make judgements. As a result, the ability to make such judgements vary between individuals and the subsequent ability to reach wisdom is reliant on people’s personal abilities and values (Ackoff 1989). Bellinger, Castro and Mills (2004) explain it differently, stating that it is about understanding: understanding relations makes data into information, understanding patterns turns information into knowledge and understanding principles creates wisdom.
From a geographic perspective, Spence (2003) considers data to be merely data that need to be organised in such a way so they become meaningful to the user, thus turning the data into information. This could be an effective map that can communicate information about the geography that it represents, making clear to the map reader the relationships that exist between the different pieces of information.

Thus, information in simple terms is data that are arranged so they become useful (Bellinger, Castro and Mills 2004). If users can also recognise inherent relationships in the information, how they operate, and identify patterns, the information could turn into knowledge. Therefore, to develop a ‘knowledge tool’, data that are related should be presented so relationships can be understood, whilst information must then be presented so users can recognise patterns and it becomes something meaningful to them. As Gahegan et al. (2001, p. 30) state, part of the knowledge construction process is to “progressively refine a large dataset to the point where it makes sense to propose object structures and relationships”.

3.2.1 What is knowledge?

In the view of Brown and Duguid (2000), knowledge tends to be connected to a person. That is, someone knows, whereas information is loose, not tied to a person. Knowledge requires that the person understands and as a result, knowledge can not necessarily be passed on easily. The receiver of the knowledge must also be able to understand, or that what is passed on will revert to mere information. Knowledge is therefore collecting and processing information (Kautz 2009).

Knowledge exists in different forms. Explicit knowledge can be described as knowledge that is clear and obvious, and can be expressed in words and numbers such as manuals, books or scientific formulae (Nonaka and Konno 1998). It can also be regarded as a form of “declarative knowledge” (Sun, Merrill and Peterson 2001, p. 205) used, for example, to perform a task like driving a car that requires an explicit set of actions. Implicit knowledge, synonymous with tacit knowledge, on the other hand, remains within a person (Barquin 2001). Surowiecki (2005, p. 71) concurs, adding that tacit knowledge is “knowledge that can’t be easily summarised or conveyed to others, because it is specific to a particular place or job or experience, but it is nonetheless tremendously valuable”. According to Weinberger (2007), it is something that people
instinctively know like taking an umbrella when the sky is dark (no explicit rules exist on what to do, but people will instinctively know it will likely rain).

### 3.2.2 Capturing knowledge

How to capture knowledge is not easily answered _per se_. As knowledge is linked to people’s own abilities and understanding (processing information), it can not simply be transferred from one person to another (Brown and Duguid 2000; Von Krogh, Ichijo and Nonaka 2000). Although explicit knowledge can be passed on by making it visible to others in books or manuals (Janson and McQueen 2007), tacit knowledge is generally regarded as difficult to capture (Janson and McQueen 2007; Surowiecki 2005). Some tacit knowledge may be transformable to explicit (Nonaka and Konno 1998), but, Weinberger (2007) states, explicit knowledge can similarly become tacit once people have learnt and it has become instinctive. Any tacit knowledge that has transformed to explicit, in theory, can subsequently be captured (Arif _et al._ 2009). According to Bhardwaj and Monin (2006, p. 72), tacit knowledge needs to be explored because it is “the source of inspiration for human actions in the work place”.

#### 3.2.2.1 A model to capture knowledge

In order to capture tacit knowledge, it needs to become explicit. Nonaka and Konno’s (1998) SECI model describes how organisational knowledge is being generated and converted. The SECI model – Socialisation, Externalisation, Combination and Internalisation (see Figure 3.2) – refers to the four characteristics involved with tacit and explicit knowledge interaction, and how this interaction can take place (individual, group or organisation).

For example, tacit knowledge can be shared with other tacit knowledge through the interaction of individuals, referred to as socialisation. Tacit with explicit, explicit with tacit, and explicit with explicit can similarly be shared in different situations and for different purposes. The end result of this knowledge sharing is the creation of new knowledge, either tacit or explicit. According to Arif _et al._ (2009), knowledge gains value if shared within an organisation, both in groups or between individuals.
3.2.2.2 Storytelling and capturing tacit knowledge

Externalisation, Nonaka and Konno (1998) state, is the process required for transforming tacit knowledge to explicit. The focus should be on dialogue and involve methods that enable people to express their ideas so that others may understand it. Techniques include the use of metaphors, analogies and storytelling. The latter, storytelling or narrative, is a key method applied to capture and transform tacit knowledge (Janson and McQueen 2007; Reamy 2002). The stories that are told expose the tacit knowledge that is hidden in these narratives (Bhardwaj and Monin 2006), and are the “carrier of the tacit knowledge…to be expressed and recorded” (Janson and McQueen 2007, p. 647). Tacit knowledge that is articulated through dialogue and interaction with colleagues is subsequently shared or passed on; when tacit knowledge is articulated, it in effect becomes explicit (Nonaka and Konno 1998).

According to Brown and Duguid (2000), stories can be useful to connect loose items either by presenting a sequential or causal connection that helps the reader or listener understand what happens and why. Listeners can then apply the stories to their own knowledge to redefine, increase or strengthen it (Janson and McQueen 2007). In practice, stories are already used in organisations to make things clear, and can be spread through the social fabric that connects people (Brown et al. 2005). From a
geographic perspective, Wood (2010, p. 29) argues that maps in atlases are “…arranged narratively, to make a point, to tell a story…”, and that the relationships between individual maps can be revealed by the ‘narrative sequence’ that is used (Wood 2010). Maps themselves can be seen as narratives about geography. This is because maps can visualise spatial relationships, trends and patterns (Kraak 2004), helping users make sense of the world through the ‘story’ of geography being told.

3.2.2.3 Capturing tacit knowledge at Parks Victoria

Parks Victoria has employed the storytelling method to capture tacit knowledge in its The Gathering of Wisdom project. The project recorded, on film, “the reflections of long serving staff on their careers in park management, including changes they have observed, unique things they have learnt and their thoughts on the future” (Parks Victoria 2009f). Forty staff members were interviewed, with the footage stored on a series of DVDs. However, it is not sure how these videos of one-hour duration will assist in passing on the tacit knowledge (J Whelan 2009, pers. comm. 27 August). One can ask who would watch these videos unless it was known that they had a relevance to a particular situation or topic. Unless technology was applied that can determine appropriate tags at certain intervals so people can make effective use of the information, the videos could merely become another data item in Parks Victoria’s vast data archive.

Another Parks Victoria research project, Knowledge Nuggets, that is currently underway, aims to facilitate the sharing of knowledge gained by staff taking part in exchange programs with Parks Canada and other park management agencies. The ‘nuggets’ represent topics that staff members are knowledgeable about – the tacit knowledge people possess. Instead of using the storytelling method, the project aims to build “…a ‘knowledge map’ to facilitate connections between the holder of the knowledge and other individuals who can benefit from that knowledge” (Parks Victoria 2011f, para. 3). A Parks Canada staff member on the other hand shares their exchange experiences at Parks Victoria beyond the organisation using a blog39.

3.3 Synthetic knowledge systems

Once knowledge has been captured, it should be stored and maintained, and become easily accessible for appropriate retrieval. Information retrieval is essential to knowledge management (Arif et al. 2009), as information and knowledge that is merely

39 Refer anwareendownunder.blogspot.com/.
lying around in people’s heads, in filing cabinets or databases instead of being available when and where it is needed have little value (Teece 2001).

For centuries, people have attempted to manage or organise information, developing what can be called information or knowledge systems that would assist in finding or accessing information more effectively. The Dewey Decimal System (DDC), developed in the 1870s by Melville Dewey, was a way to organise and help find books and was so successful that it is still in use in libraries as well as on the Web (OCLC 2009). Bush (1945) noted in the middle of the 20th century that without a system in place, too much time and effort could be spent on finding relevant information, if found at all. The key to finding information more easily is organisation – how it is structured and classified. Information retrieval is about indexing and searching (Mills 2004) guided by classification of the information. Additionally, classification is about representing knowledge (Kwasnik 1999). Mills (2004, p. 541) states that classification is the “basic intellectual instrument” people use to understand things. Classifying information means that inherent connections between different components and in structures can be visualised and understood (Kwasnik 1999).

3.3.1 Classification methods

Traditionally, information has been systematically structured and categorised using scientific or rational ideas about knowledge (Zimmer 2009). Generally this has been a thematic or topical classification, the “traditional tree of knowledge” (Burke 2000, p. 184) or a hierarchical tree (Bolter 2001). Zimmer (2009, p. 98) refers to the “encyclopaedic organization of knowledge”, a method that breaks down information into different levels, ranging from very broad to very precise, and with various subcategories in place to help allocate a precise location for each piece of information. For example, flora and fauna species are categorised in this way, or the world can be divided geographically from broad to specific: from continent, to regions, to country, to state or province, and finally city, town or village. The aforementioned DDC uses the same principles for the categorisation of books (OCLC 2009). These classification methods, Zimmer (2009) states, aim to maintain the relationships between data.

A perceived disadvantage of these systematic structures is that they possess a preconceived bias. That is, it was pre-determined how things were to be structured based on a decision-maker’s knowledge and understanding (in other words their bias),
“...protecting us from what isn’t worth our time and helping us find what we need to give our beliefs a sturdy foundation...”, as Weinberger (2007, p. 132), perhaps somewhat mockingly, puts it. Any type of systematic classification as such contains this bias. Intranets are an example of a biased systematic structure. These internal communication boards of organisations often merely reflect the viewpoint of management (McAfee 2006), and are designed by a select group who have decided what is important and how this should be presented and organised. In contrast, Weinberger (2007) is enthusiastic about the neutrality that Wikipedia aims to achieve in its pages. With Wikipedia, there is no biased, hierarchical system in place, but rather a collaborative approach as to what should be included and how it should be worded. The information in Wikipedia pages, unlike say in Encyclopaedia Britannica, can therefore be regarded as a ‘negotiated middle way’ rather than one particular ‘informed’, regulated viewpoint.

Another much used method is an alphabetical organisation (Burke 2000; Zimmer 2009). This, Weinberger (2007, p. 26) states, is perhaps “unnatural and arbitrary”, it is also something that is widely accepted because of the randomness in the system. There is no inherent bias or suggestion that something has been placed higher in the order because it is more important or carries more weight. It is mere fate (depending on the first letter of the description) that determines the resulting structure, something Zimmer (2009) suggests is not necessary ideal either. Adler (cited in Weinberger 2007) goes one step further, arguing that an alphabetical structure goes against human intellect. It is important for humans to be able to find the connections in information so that it can be understood and learnt from. “Understanding...means seeing the connections (Mills 2004, p. 541), and classification is a primary tool to make those connections visible.

Both non-biased and non-arbitrary, faceted classification is a means to classify information in different ways using a range of properties or attributes or ‘facets’ (Kwasnink 1999). This is essentially a non-biased classification method as Kwasnink (1999, p. 39) states that “The notion of facets rests on the belief that there is more than one way to view the world...”. Furthermore, according to Star (1998, p. 218) faceted classification systems were developed especially to counter the “powerful entrenched a priori schemes with claims on universality”. A faceted classification system is multidimensional, and allows people to search for information from different perspectives, encapsulated in the wide range of attributes applied (Uddin and Janecek
Broughton (2001) points out that faceted classifications are not as simple as some consider it to be, and that the complexity of the process is often misunderstood. Faceted classifications have been applied in library and information science for decades (Star 1998) and are now regarded as a useful means to classify digital data (Broughton 2001; Uddin and Janecek 2007). Similarly, the term ‘faceted browse’ on the Web refers to the ability to refine search options (Scott and Neill 2009). By using a variety of filters – essentially parameters or facets – relevant information is more easily found.

Lastly, other organising methods include using paradigms – particularly suitable for two dimensional data (Kwasnik 1999) – size, chronology (Denton 2009) or colour. A colour-coded classification system could be applied to books (see Figure 3.3). Although such a design-focused system would primarily seem to be for aesthetic purposes rather than functional ones, organising books by colour instead of by genre, author or alphabet could benefit visual-oriented people (Sarah C 2009).

![Figure 3.3 - Books organised by colour.](Source: mindonfire 2009, www.flickr.com/photos/mindonfire/3956865159/in/pool-96822943@N00. Accessed 21 December 2009. Permission to use: Creative Commons license Share Alike 2.0. CC BY-SA 2.0)

### 3.3.1.1 Classification of Parks Victoria data

Parks Victoria’s data can be classified in multiple ways, and both geographically and thematically. Most data are linked to geographic locations that conform to a treelike structure – from the whole park network down to district or regions, one or more parks,
to locations or routes within a park for instance. In addition to Parks Victoria’s own geographical structure, other geographical hierarchies can also apply. Examples of such hierarchies are administrative boundaries, the Victorian Government’s fire management structure, bioregions\(^{40}\) and the Bureau of Meteorology’s weather districts.

Parks Victoria’s data can also be arranged in non-geographic ways through a range of themes and topics, with data often covering multiple themes. An analysis of references collected for a particular research paper showed that those references were also relevant to a range of other subjects in varying degrees. Figure 3.4 is a portion of the Excel spreadsheet produced (see Appendix I for the complete first page of the five page document comprising 141 references in total).

<table>
<thead>
<tr>
<th>Source</th>
<th>Rating</th>
<th>History (pre settlement)</th>
<th>History (post settlement)</th>
<th>Governance</th>
<th>Geomorphology</th>
<th>Geology</th>
<th>Hydrology</th>
<th>Flora</th>
<th>Fauna</th>
<th>Grazing</th>
<th>Ecology</th>
<th>Management Action</th>
<th>Fire</th>
<th>Climate</th>
<th>Climate change</th>
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</thead>
<tbody>
<tr>
<td>Environmental Research</td>
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<tr>
<td>Degree of Doctor of Philosophy</td>
<td>A</td>
<td>2</td>
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</tbody>
</table>

Figure 3.4 - Portion of Excel spreadsheet showing that data, references for a research paper in this instance, can be relevant to multiple topics in varying degrees.

(Source and copyright: J Whelan, March 2009)

The numbers 1 – 3 indicate the relevance or value of the information, with 1 being highly relevant to a particular topic, and 3 providing some relevant information (a ratings system A – C is similarly applied to indicate the relevance of the references to the actual research paper for which they were collected).

\(^{40}\) Bioregions are areas with common ecological characteristics including geology, land forms, climate, and flora and fauna communities. Victoria base 28 bioregions (Department of Sustainability and Environment 2011e).
Parks Victoria’s data would therefore benefit from a classification system that allowed for the data to be organised using different thematic and geographic attributes, and essentially providing a multi-faceted classification. Such a system would make the data findable for users with different purposes.

3.3.2 Knowledge systems based on hypertext

Perhaps because knowledge is about understanding relationships and patterns, people have envisioned knowledge systems that would be able to link related documents. Bush (1945) wrote that in order for people to find the information they require, they had to understand how the classification system worked and which search path to follow to arrive at the right information.

An early example of a linked knowledge system is the *renvois*, invented in the 18th century by Denis Diderot. The *renvois* is a precursor of hypertext that utilised cross-references and was applied in Diderot’s book *Encyclopédie* (Zimmer 2009). A strength of the *renvois* system was that the cross-referencing mechanism meant that readers would come across articles that depicted opposing viewpoints (Vanpée 2002). This unsettled traditional notions about knowledge being “singular and infallible”, Zimmer (2009, p. 104) states, in that it relied on people thinking and learning for themselves by making up their own minds after construing the different pieces of information presented to them.

A second knowledge system and antecedent of hypertext is the Memex (short for memory extension), aimed at linking different documents with a focus on associative relationships (Bush 1945). Vannevar Bush’s vision for the Memex was that people would store their search path, linking to pages and documents as they found them so that they could return to them if needed, or move between different sections as needed. The Memex therefore was a hypothetical personal index system, although it was envisioned that the ‘trail’ could be passed to others for storage in their personal Memex systems (Bush 1945).

The actual term hypertext was coined in 1965 by Ted Nelson, by which he meant “non-sequential writing -- text that branches and allows choices to the reader…” (Nelson 1992, p. 0/2). By creating hyperlinks in text, thus connecting different documents,
readers could choose how they wanted to continue reading, and connect to related topics and information. According to Nelson (1992), if information is presented in a sequential manner, it can conceal the proper relationships that exist between and within that information. Furthermore, as with systematic classifications, an inherent bias is present in sequential structures. Although logic or rational methodologies may have been applied, the final structure displays only one viewpoint.

To put hypertext into practice, Nelson (1992, n.p.) invented a system that was to be “…a computer program intended to tie everything together and make it all available to everyone”. The Xanadu project was designed to store and link text and other data that were to be published electronically to provide universal access (Nelson 1992). Xanadu never officially eventuated, which, Bolter (2001) argues, was in part due to the sheer amount of data that needed connecting in Nelson’s vision. Ideas behind the project appeared in other forms nonetheless such as the Web browser Mosaic, aimed at consumers rather than scientists, and the general revolution of the Web as the new mass medium (Saleton 1998). Apple’s HyperCard introduced in 1987 was also based on the Xanadu concept (Ihnatko 2003). It stored information in ‘cards’ that could be linked to each other (Kahney 2002), allowing people “to construct webs of links within their personal computers” (Saleton 1998, para. 12). However, the information was only linked on one computer, unlike Nelson’s vision of linking documents on multiple computers. Users could also personalise HyperCard software to suit their needs, rather than having to adapt their habits to suit the software (Ihnatko 2003). Although various versions and upgrades were made, other software eventually superseded HyperCard.

The Internet and World Wide Web are both built on hypertext and hyperlinks (Zimmer 2009), the latter encompassing different media types like images, videos as well as text. Although its potential was understood, it was not initially recognised during the development of the Web that hypertext would be the key to information access (Berners-Lee and Fischetti 2000). The principal idea of hypertext is arguably also found in scholarly articles, albeit in non-digital form. For example, when reading a journal article, there will be various footnotes and citations that lead to other articles relating to that issue (Landow 2006).

The previously described Renvois, Memex and hypertext systems contain the premise that relationships between information should be based on association, breaking away
from systematic organisation and opening new ways to gain knowledge (Zimmer 2009). Different people have different associations, depending on individual experiences and preferences. Furthermore, the human mind can “make intuitive leaps across the boundaries – those coveted random associations” (Berners-Lee and Fischetti 2000, p. 10). What may work for one person therefore, may not work for another. The systems additionally acknowledge an underlying notion that there is no definite structure in which to store information and knowledge, simply because the complex nature of elementary data and their relationships do not allow for this (Bates 2002). Arguably, faceted classification systems are able to capture some of this complexity, allowing for the multidimensional nature of data and multiple viewpoints.

The goal of Bush’s Memex was to “invent new information systems to help users locate, organize, coordinate and navigate through… information, and to free them from the constraints of rigid systems of classification and data organization” (Zimmer 2009, p. 105). This goal encapsulates notions of Web 2.0 such as sharing of information, a bottom-up organisation, and personalised tagging.

### 3.3.3 Geographically oriented knowledge systems

The volume of geographic information has increased (Dykes and Mountain 2003; MacEachren and Kraak 2001; Miller and Han 2009). Maps have traditionally been used to depict geographic information – information linked to a location on the Earth (Gore 1998). Because maps structure and organise data and are able to depict information effectively (Robinson et al. 1995), maps can be regarded as compact knowledge systems. As MacEachran (1995) states, maps can stimulate ideas; it is not just about communicating a particular message from the map maker to the map user, but the map user can use the information presented and propose their own ideas, construct their own knowledge. With technological advancements, maps have developed from traditional two-dimensional paper versions to digital maps that can be dynamic, interactive or three-dimensional visualisations providing access to connected information, thus strengthening people’s ability to explore, analyse and process the information presented via the map.

In 1998, in line with both the increase in geographic information and technical developments, Al Gore, then Vice President of the United States of America, outlined his conception for a geographically oriented knowledge system Digital Earth. This was
to be “…a multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data” (Gore 1998, para. 4). In his speech, Gore (1998) explained how new technologies had resulted in a vast amount of this information being generated, but that most of it was not being used and was merely stored away instead of being used to acquire knowledge. His vision of a three-dimensional model of the Earth would provide access to spatially referenced data stored unorganised in digital knowledge archives around the world (ISDE5 2007); “…arrayed in a recognizable pattern within which each bit gains meaning in relation to all the others” (Gore 1998, para. 3), unorganised data may become meaningful and turn into knowledge.

Gore’s Digital Earth is a conceptual model, and it continues to be developed along two paths (ISDE5 2007). Firstly, a cross-section of global organisations, including private businesses, NGOs and governments, work together towards the goal of building technical and educational opportunities for the exploration of geographic information and applying common standards, tools and databases on a global level. The second path is being developed by organisations such as Google, Microsoft, and MSN through their provision of mapping platforms like Google Maps, Google Earth and Bing Maps. Mapping mashups and other Web mapping applications used to display georeferenced information are in effect small versions of the Digital Earth Gore envisaged. Google’s mission complements that of Digital Earth by wanting to give the public more access to geographical information (Parsons cited in Verduyn 2009), achieved through its mapping tools.

3.3.4 Other applications of knowledge systems

A number of knowledge systems, either conceptual or existing, have thus far been described: the Memex and hypertext systems, maps and Digital Earth. Databases and Artificial Intelligence or so-called ‘intelligent machines’ (McCarthy 2007) are seemingly related to knowledge systems, in part because they are associated with the essence of such systems: knowledge creation and decision-making. The two are briefly discussed in the following sections.

3.3.4.1 Databases

Databases form part of the infrastructure of knowledge systems, and provide a means to store, access and manipulate data (Fayyad, Piatetsky-Shapiro and Smyth 1996). More
importantly, knowledge can be generated from databases through a series of steps that range from “data manipulation and retrieval, to mathematical and statistical inference, … search strategies and human reasoning processes” (Fabrikant 2000, p. 66). In order to generate knowledge from data, what Fayyad, Piatetsky-Shapiro and Smyth (1996, p. 28) describe as “discovering useful knowledge from data”, it is necessary to find useful patterns, a process also referred to as data mining, knowledge extraction or information discovery. Special algorithms can be applied to automate this task. To reduce the vast amount of data in a database to a point where patterns and relationships become visible, the full process also involves selecting and preparing appropriate data, applying existing knowledge, and interpreting the results. Selecting and preparing data can be aided by data classification and attaching keywords, thus enabling appropriate data retrieval.

The number and extent of spatial databases (as opposed to non-spatial ones) is growing (Ester, Kriegel and Xu 1995), with many digital databases increasingly contain spatial links (Gahegan et al. 2001). Spatial databases are specifically able to deal with the spatial element of data, whilst geographic approaches like geographic visualisation and spatial analysis benefits access and interaction with the data stored in these databases.

3.3.4.2 Artificial Intelligence

The transformation from data to information to knowledge requires a person’s understanding of relationships and patterns (Ackoff 1989), and their ability to think and learn and grasp meaning. Or as Burke (2000) states, individual intelligence plays a role in acquiring knowledge. Thus, in order to understand how intelligence works, it is necessary to understand “how knowledge is acquired, represented and stored” (Albus cited in Nilsson 1998, p. 1). Artificial Intelligence (AI) investigates, simulates and attempts to manage knowledge (and intelligence). According to Vlahavas and Bramer (2009), knowledge creation (engineering), knowledge representation and decision support systems are linked to AI, confirming AI’s association with knowledge systems.

AI put simply is about intelligent machines and intelligent computer programs, with the aim of developing a system that is able to achieve goals and solve problems just as humans do (McCarthy 2007). This idea of creating a ‘mechanical mind’ has long existed, exemplified in Mary Shelley’s 19th century Frankenstein (Carter 2007). After the Second World War AI research shifted from building machines to programming computers (McCarthy 2007), resulting in modern computational AI.
Russell and Norvig (2003) discuss four categories of intelligent machines: ones that think like humans, ones that think rationally, ones that act like humans, and ones that act rationally. However, AI is not about simulating human intelligence per se, McCarthy (2007) points out. Solving problems requires completing a series of tasks and each task in turn requires the completion of a series of intelligent mechanisms. Because an intelligent machine can only be as intelligent as the programmer’s ability to reproduce those mechanisms into the computer, it seems that AI will not necessarily be more intelligent than humans but instead be able to assist humans.

AI is applied in the optimisation of networks, information retrieval and search engines, for Web mining, online trading and data classification (Sugumaran 2009). It is used in many fields ranging from educational and medical to defence and the environment.

3.4 The Web as a knowledge system

When developing the Web, Tim Berners-Lee (Berners-Lee and Fischetti 2000, p. 33) had a vision of “…a system in which sharing what you know or thought should be as easy as learning what someone else knew”. The Web and digital data repositories that give instant access to related information, arguably, have made learning and gaining knowledge more accessible.

3.4.1 Knowledge on the Web

Weinberger (2002) suggests that the Web has changed the traditional basic view of knowledge, regarded to be devoid from emotion or perspective, and accepted unanimously. Knowledge on the Web, however, “is a social activity…[that] happens when people say things that matter to them, others reply, and a conversation ensues” (Weinberger 2002, p. 140). As knowledge has both a human and creative aspect (Von Krogh, Ichijo and Nonaka 2000), it is suggested that user participation and interaction at the heart of Web 2.0 is indeed a means for new knowledge creation (Chatti and Jarke 2009). Because people share information with others, information and knowledge is passed around, absorbed and contemplated and, subsequently, new information and knowledge can be created. And this knowledge is not passed on from some higher authority but is a peer to peer effort. According to Surowiecki (2005), knowledge is gaining additional value as it is spread around because more people can utilise it for more reasons.
The revised view on knowledge is essentially due to the greater prominence of the social aspect of knowledge. Knowledge is not just in individual minds, but is instead between everyone (Brown and Duguid 1998). Social and individual knowledge now exist (Von Krogh, Ichijo and Nonaka 2000), which, Weinberger (2007) argues, is the result of the public and social thinking. Therefore, if individuals work together, collaborate and share information in order to get better at something (Shirky 2008), in so-called “communities of practice” (Brown and Dugu id 1998, p. 91; Wenger 2006), new knowledge will be generated. However, Burke (2000) states that for individuals to acquire knowledge, apart from their own personal abilities such as intelligence, they also require access to information. Therefore, because Web 2.0 allow people to share more easily, whilst the Web itself has given people easy access to a wider range of information, new knowledge is being created on the Social Web at an even faster pace.

3.4.2 Data organisation on the Web and hyperlinks

The Internet and the Web changed the way data and information are collected, stored and organised (Zimmer 2009). Arranging digital data eliminates some of the drawbacks associated with existing hierarchical structures: the single location of a document (Bush 1945; Weinberger 2007) and the preconceived bias inherent in systematic classifications (Weinberger 2007; Zimmer 2009). On the Web, physical space is not an issue and in the digital world of the Web, many documents can link to many other documents, and “things can get assigned multiple places simultaneously” (Weinberger 2007, p. 14). This linking mechanism simultaneously solves the problem of the preconceived bias. Although a structure can still be systematic in nature, it can now be structured in more than one way. The use of hypertext and hyperlinks that the Web is built on, what Weinberger (2002, p. 49) calls the “geography of the Web”, is a means for readers to follow different search paths. It is suggested that linking a broad range of information, including contradictory viewpoints that forces people to think, gives readers the chance to find the information they want and gain knowledge (Zimmer 2009).

Some websites arguably still have a systematic structure in place including some form of bias. For example, authors may choose links that may only support their view, or sites may be designed to keep users within the site itself, thus restricting them to the information provided by that site (and the authors and their perspectives). However, the Web as a whole still provides the online reader with immediate access to other viewpoints, only a mere Google search away.
Websites can provide links to other information that at first glance would not appear connected. On Wikipedia for instance, any topic contains a range of hyperlinks to other topics including basic words that are not necessarily directly related. Figure 3.5 displays the Wikipedia page for ‘knowledge management’. The words in blue are hyperlinks to topics ranging from insight and experience, to computer science, public health and objectives.

Figure 3.5 - Part of Wikipedia’s entry on knowledge management.

Linking this much information may well be information overload, but it may equally mimic the ‘random associations’ the human mind can form that Tim Berners-Lee talked about (Berners-Lee and Fischetti 2000). According to Berners-Lee and Fischetti (2000), Nelson’s hypertext was regarded as a potentially useful component of the development of the Web, and is seemingly an essential component of any digital repository nowadays. Landow (2006) states that blogs, wikis and the like are good attempts of putting into practice how Nelson and others envisaged hypertext could work. Web users are both readers and writers and can link anything to anything using hypertext and hyperlinks. Within the realm of Web 2.0, linking related information is also achieved through tagging – documents tagged with the same keyword are easily found. And the use of tagging to connect documents may well remove any remaining bias, as tags can be created collectively by readers.

3.5 Collaborative knowledge systems

Collaborative knowledge systems are regarded to be built collectively, making the management or organisation of information and knowledge a team effort. The Social Web is arguably a collaborative version of the original Web. The participatory tools enable users to contribute and share information and knowledge, generating new
information and knowledge in return. Web 2.0 thus enables the creation of collaborative knowledge systems, and perhaps, in the current era, is the essence of such systems.

Web 2.0 tools are increasingly being used by organisations (McAfee 2009b) for various reasons including for Knowledge Management (KM). KM is viewed as a knowledge system, as it is a means to manage and organise data, information and knowledge inherent within companies. Because underlying this research project is the management of data at Parks Victoria, the topic of KM is explored further. KM is evolving and being conducted in increasingly collaborative ways, including at Parks Victoria (discussed in more detail in Chapter 4.4), utilising Web 2.0 tools and applications.

3.5.1 Knowledge management

KM became a key concept in the 1990s for businesses (Von Krogh, Ichijo and Nonaka 2000) after it was recognised that knowledge is something that can benefit companies and thus should be ‘managed’ in order to optimise its advantages. Traditionally, KM has focussed on the information systems and technology area of knowledge (Kautz 2009), whilst explicit knowledge has generally dominated tactic knowledge (Mulder and Whiteley 2007). By using the term ‘management’ it is suggested that knowledge can in fact be controlled. However, this may not be possible, or be difficult at least, because of the human actions associated with knowledge including “creativity, conversation, judgment, teaching and learning (Von Krogh, Ichijo and Nonaka 2000, p. 4). These are not necessarily controllable, and may even be suppressed if managed too much. Von Krogh, Ichijo and Nonaka (2000) therefore suggest the ‘enabling’ of knowledge rather than ‘management’, achieved through a stimulating environment that encourages participation and communication. These in turn facilitate knowledge sharing, an important part of KM according to Kautz (2009). Essentially, information should flow between departments without limits or restrictions (Joyce, Nohria and Roberson 2003), whilst information, knowledge and resources should be sourced from both within the company as well as from outside (Tapscott and Williams 2008).

Farmer (2009) identifies three steps in new KM practices: listen, engage, and influence. The order is important, as to try and influence (for example staff or clients) without having listened or engaged will most likely be unproductive. The computer technology company Dell is an example of an organisation that listens to and engages its clients
before making decisions. Its online community portal IdeaStorm\textsuperscript{41} is a means for Dell clients to post ideas for the company to develop. These ideas come directly from Dell users, and are therefore based on what Dell’s customers need or want rather than what Dell thinks they may need or want. The company appears genuine in its approach as it follows through on the ideas, checks their feasibility and so on, with 480 ideas implemented out of over 16,600 contributed as at 07 February 2012 (Dell 2010).

3.5.1.1 Top-down versus bottom-up organisation

Like the classification structures discussed in section 3.3, the formal treelike and alphabetical structures versus the linear and associative approaches of hyperlinks and tagging, organisational structures experience a similar issue. Traditionally, company structures have been formed from the top-down (Surowiecki 2005), consisting of an hierarchy where authority diminishes the lower in the hierarchical structure one is situated (Tapscott and Williams 2008). A key problem inherent in hierarchical structures, Surowiecki (2005) states, is the inevitable lack of a smooth and easy flow of information as a result of the multiple managerial (and bureaucratic) levels it has to pass through.

As an alternative to top-down organisations, Chatti and Jarke (2009) argue that social media can create communities from the bottom up; emerging naturally as a result of the overlapping of individual networks and activities. According to Johnson (2001, p. 21), such a “network of self-organisation” can result in the development of intelligence and learning, brought about by the “collective intelligence” (Johnson 2001, p. 29) of individuals. These “communities of practice” (Brown and Duguid 1998, p. 91; Wenger 2006) engage, do things together, share information and knowledge, and have a collective understanding of issues such as work, goals and responsibilities. Communities within organisations created through social media should thus ultimately benefit those companies.

Although it is generally acknowledged that hierarchical structures within organisations will not be eliminated, ‘flatter’ structured organisations are increasingly emerging (Tapscott and Williams 2008). They can result in better responses, new developments, lower costs, greater flexibility and an enhanced image to the outside world, although Hoopes (2003) argues that giving more authority to lower management can have

negative results, and something that can be difficult to reverse in hindsight. Davenport (2007) believes that hierarchical systems will remain due to existing cultures, the importance of power within an organisation, lack of incentives and trust in others (peers, bosses, subordinates). Whilst agreeing, McAfee (2009a) adds that organisations should probably have less hierarchy, management and bureaucracy than they do. Joyce, Nohria and Roberson (2003, p. 156) concur that these should be minimal, but conclude that, theoretically, “some [bureaucratic] procedures and protocols are absolutely necessary to the smooth functioning of any large organization”.

3.5.1.2 Decision-making process

Knowledge and KM are linked to decision-making. According to Ackoff (1989), knowledge is the tool that transforms information into directives. Knowledge, Courtney (2001, p. 23) argues, is “information with guidance for action, that is, knowing how to act given the information”. Collecting data, information and knowledge will lead to a better understanding of the situation (Bolloju, Khalifa and Turban 2002), and thus result in better informed decision-making.

The three phases in the decision-making process, Simon (cited in Courtney 2001) states, comprise 1) intelligence - recognising the need for a decision by identifying existing problems; 2) design - developing methods to solve it; and 3) choice - assessing the alternatives and deciding which one to apply. Knowledge can be gained from a combination of internal and external information, and tacit and explicit knowledge. When people make decisions based on the information at hand, it means assessing which bits of information are more important (Weinberger 2002). The emphasis is on the value attached to these pieces of information; fitting them together to create a full picture of the situation will guide the decision.

Early computer based Decision Support Systems recognised the human element in decision-making. The human decision-maker would ultimately use their judgement to make the final decision (Gorry and Scott Morton 1971). According to Surowiecki (2005), decision-making is generally enhanced if it is made by people closely associated with the problem who possess knowledge, particularly tacit knowledge, in relation to the problem. Making difficult decisions is often based on having access to almost too much information that is conflicting in nature or contains discrepancies (Weinberger 2002). Additionally, as Surowiecki (2005) explains, as experts often do not agree on an
answer, a collaborative approach to decision-making rather than relying on individuals may provide better solutions. Courtney (2001) describes how Group Decision Support Systems were employed within organisations in the 1980s and 1990s, facilitating collaborative problem solving at a team level. The arrival of Web 2.0 could enhance this further, although it would have to go hand in hand with a flatter hierarchical system. If the outcomes of more democratic decision-making processes still have to go through the managerial hierarchy, by the time it gets to the top, the solution will no doubt be ‘watered-down’ (Surowiecki 2005).

3.5.2 Enterprise 2.0

Enterprise 2.0 is a term coined by McAfee (2006) to describe organisations that are using social software to do business and achieve their goals (McAfee 2009b). The use of social media by organisations has evolved from a “pioneer phase to a broader acceptance phase” (Hinchcliffe 2007, para. 3). Major Web 2.0 tools like wikis, blogs, RSS, podcasts, social networking, tagging and mashups, are used to various degrees by companies globally (Carr 2007). Research in 2009 showed that almost 50% of companies around the world would utilise such tools (Hinchcliffe 2009b) and 2011 statistics confirm this is the case in Australia at least, with 50% of large business using social media (Sensis 2011). Furthermore, a broad range of organisations are applying Web 2.0 tools – in the United States, Asia and Europe (Carr 2007) as well as in Australia. In August 2009, the Victorian Knowledge Management Roundtable (KMRt) held a meeting that was attended by people from oil companies, health insurance providers, charity organisations, banks and Parks Victoria – a park management organisation. Considering the outcome of the research project and developments at Parks Victoria (described in more detail in Chapter 4.4), the organisation was regarded to be, or at least heading towards being, an Enterprise 2.0 company.

3.5.2.1 Enterprise 2.0 culture

It is generally acknowledged that different Web 2.0 tools will suit different companies (Dawson 2009a; McAfee 2009a). Besides employing such tools, an organisation’s culture must be right for these to be successful (Hinchcliffe 2009a; McAfee 2006, 42).

42 The KMRt group in Victoria comprises different organisations that collaboratively explore the new road KM is taking through the discussing and sharing of opportunities, technologies, experiences and other issues (KMRt Victoria 2009).
just like seeking staff participation and collaboration in order to create knowledge requires a supportive environment that promotes this (Von Krogh, Ichijo and Nonaka 2000). Participation is a cultural phenomenon rather than a technological one (Jenkins et al. 2006), and therefore must be fostered and encouraged so that it emerges naturally. Forcing people to participate will often achieve little, if anything. Nonetheless, social media tools must be taken up by a minimum number of people for it to be effective, and the more people use them, the more useful the tools become (Dawson 2009b). O’Reilly (2005) agrees. For example, an information structure will not emerge if only three people in the company were applying tags, just like eBay and Amazon would not succeed if it were not for the amount of users that use their sites. Surowiecki (2005) believes that the larger and more diverse groups are, the more effective they become in finding the right answer. If every individual knows a bit of the puzzle, the more individual bits are combined will inevitably assist in creating a better outcome. Lastly, according to Hinchcliffe (2007), benefits provided by Enterprise 2.0 to an organisation only emerge over time, and are thus not necessarily visible immediately. The culture must therefore be right at all levels so that Web 2.0 tools can become viable within an organisation. Managers must understand their impact, and encourage staff, and staff must in turn understand their roles, how the tools work and how they will benefit both them and the company. And there lies the necessary hierarchical system…

Just like Web 2.0, some regard the term Enterprise 2.0 as overrated. Howlett (2009) argues that receiving customer feedback through forums and utilising that information to benefit the company is nothing new, whereas Davenport (2007) states that Web 2.0 may allow staff to bring up ideas, it will not diminish power structures and other organisational hierarchies. McAfee (2009a) agrees that some company structures will always remain, but argues nonetheless that these tools may benefit companies in that they can organise work and information from the ground up, reflecting “the way work really gets done” (McAfee 2006, p. 21).

### 3.5.3 Inter-organisational knowledge sharing

Three types of collaboration and participation have already been named: internally between staff, and externally between company and customers (like Dell) or between different companies (like KMRt). The last named group, collaboration and information sharing between companies, has emerged in a variety of forms. The Cochrane
Collaboration\textsuperscript{43}, for example, was set up to make particular healthcare information that is both current and accurate available whenever and wherever it was needed. The not-for-profit organisation is independent and “…benefits from thousands of contributors worldwide, working collaboratively from within many independent groups of people” (Hetherington 2005, para. 2). OpenWetWare\textsuperscript{44} is a similar form of collaboration for people in the biology and biological engineering realm.

In the natural environment sector that encompasses Parks Victoria, the International Union for Conservation of Nature (IUCN), a global environmental organisation founded in 1948 (International Union of Conservation of Nature 2009), shares its publications and other information freely with others. This sharing is more or less a one-way street however, rather than being a collaborative process, although Facebook, Twitter, YouTube and Flickr are now employed to further inform (and in turn allow for feedback from others).

Parks Forum is the peak body that represents parks management agencies in Australia, New Zealand, Canada, the United States and the United Kingdom (Parks Forum 2011b), whereas the International Federation of Parks and Recreation Administration (IFPRA) has a similar purpose but on a larger scale with members from over fifty different nations (International Federation of Parks and Recreation Administration n.d.). In September 2009, neither organisation actively shared documents, although collaboration was (and is) happening through, for example, working groups in the case of the IFPRA. Moving to February 2012, and Park Forum's website\textsuperscript{45} includes an online resource database with members able to both access and upload information they wish to share. An online forum is still under construction with the aim of providing "...participants with the opportunity to network with colleagues and engage in discussions and real-time meetings on issues relating to parks management...and use them [the forums] for cooperative work with other agencies around the world" (Parks Forum 2011a).

Parks Victoria actively shares knowledge with Parks Canada (in charge of managing parks on behalf of the Canadian Government) through a regular exchange program that ensures staff members from both organisations learn from their counterparts in many aspects of park management. The aforementioned Knowledge Nuggets project aims to

\textsuperscript{43} Refer www.cochrane.org.  
\textsuperscript{44} Refer www.openwetware.org.  
\textsuperscript{45} Refer www.parksforum.org.
disseminate this knowledge further amongst Parks Victoria staff (Parks Victoria 2011f). Nonetheless, during a review meeting held at WPNP in April 2009, it was noted that knowledge sharing in the form of easy access to information from other sources other than Parks Victoria's own research is lacking. It was discussed during the meeting that the European wasp (Vespula germanica) had become a new presence at WPNP, but it was unknown if any external research existed that could potentially assist with the species’ management.

Knowledge sharing between organisations that are alike, that manage similar types of businesses and subsequently pursue similar goals should arguably be easier to achieve if there is no competitive hindrance (although it is no doubt harder when economics and self-interest are involved). From Parks Victoria’s perspective, an organisation in charge of managing national parks, having collaborative relationships with sister organisations in other states or countries that involves knowledge and information sharing could only benefit both parties. At the same time, the KMRt group shows that collaboration between organisations in different fields can also be beneficial to discuss issues they may have in common, like knowledge management.

3.6 Adding location to (collaborative) knowledge systems

Apart from the participatory and collaborative Web 2.0, the research project considered Web developments in the geospatial realm for the design of a conceptual GKT. Introduced briefly in Chapter 2.4, Where 2.0 provides a link between Web 2.0 and the Geospatial Web, in turn defining the increasing amount of geographic information and mapping applications available via the Web (Crampton 2009). As noted in section 3.3.3, Gore (1998) understood the potential value this geographic information would hold through his conceptual Digital Earth. Both location and place are on track to become core elements of information technology (Hudson-Smith et al. 2009b). Furthermore, the networks created by Web 2.0 tools such as blogs and wikis, what Gordon (2007, p. 885) describes as “networked social media… [that] functions to connect people and their content to one another”, have an increased focus on location. Subsequently, location and location technologies have become a key aspect of many emerging Web applications by making information accessible via maps and mapping mashups. The next development in knowledge systems therefore has a ‘geo’ component added – becoming both geographically oriented and collaborative systems, in line with this research project’s aim and the proposed GKT.
3.6.1 Geographic information

The key is geographically referenced data, with maps traditional means to visualise and access this type of information. Geographic information is a particular form of information that is characterised through a spatial and temporal component (Raper et al. 2001). According to Cartwright et al. (2001, p. 46), geographic information can be represented “at scales that cannot be experienced and… depict… the non-visible (e.g. mortality rates or temperatures)”, which is where it differs from the visualisation of non-geographic information. Hudson-Smith et al. (2009b) state that it is about geographic connections, the location and place of information within networks.

MacEachren and Kraak (2001) suggested in 2001 that around 80% of digital information is linked to a geographic location, which may well be higher now with the introduction of GPS enabled mobile devices such as phones and cameras alone. Emerging terms like ‘volunteered geographic information’ (Goodchild 2007) highlight the geographic element inherent in Web 2.0 and the ensuing UCI. This is why Google may be able to accomplish its mission “to organise the world’s information using geography and tools…” (Verduyn 2009, p. 7), because the geographic attributes of digital information permit information from different sources and of diverse nature to be seamlessly integrated and linked (MacEachren and Kraak 2001).

The briefly discussed geotagging (see Chapter 2.2.3) is a simple method to georeference information. The ABC website attaches tags and geotags to all its news articles, with the geotags describing the geographic locations relating to articles ranging from countries, regions or states, to cities and towns using postcodes. Once information has this geographic attribute, it can be accessed and visualised based on that location. The ABC is achieving this through its ABC Earth project46. The geotagged news articles and other ABC content dating back 50 years including videos and images, can now be viewed using Google Earth (ABC 2012). Figure 3.6 is a screenshot of ABC Earth showing news articles for Victoria, Australia.

46 Refer www.abc.net.au/apps/earth.
3.6.2 Geographic visualisation and maps

Traditionally, geographic information has been visualised using maps (Raper et al. 2001). Maps are graphic representations of a selection of the Earth’s features (Robinson et al. 1995) or a portion of the world, simplified and visualised in an abstract manner (MacEachren 1995). Maps, Weinberger (2002) states, are able to present both detailed information and the bigger picture at the same time. According to Kraak (2004), computers, GIS, the Web and the Internet have changed maps and the way they function. Maps are not just merely paper documents, one off representations of a moment in time, but in their new digital form allow for instant updates (Wood 2003) and interactivity, providing users the opportunity to explore and create purpose-specific products (Robinson et al. 1995). Maps can be created on-the-fly and be distributed easily (Kraak 2004) via the Web and other means; they have become mobile and ubiquitous.

Research into human-computer interaction has considered the development of natural interfaces to access information (MacEachren and Kraak 2001). This has resulted in many innovative approaches for the visualisation of geographic information (Cartwright et al. 2001). One natural interface is, arguably, the map. Because maps are able to
arrange information in a structured, organised manner (Keates 1989) in a way that map users can better understand that information, they are regarded as a useful means to access a variety of information (Burkhard and Meier 2004; Dykes and Mountain 2003). According to MacEachren and Kraak (2001, p. 5) maps can become “dynamic portals to interconnected, distributed, geospatial data resources”. The many mapping mashups available, Kraak (2004) suggests, shows that the Web already provides the opportunity for a map to be the interface to access other information, both geographic and non-geographic. If well designed, the map interface “can support productive information access and knowledge construction activities…” (MacEachren and Kraak 2001, p. 4).

The arrival of geospatial platforms like Google Earth, Google Maps, Microsoft’s Bing Maps (formerly Virtual Earth) and World Wind by NASA have made mapping more prevalent (Hudson-Smith et al. 2009b; Scharl and Tochtermann 2007), what Crampton (2009, p. 91) calls an “explosion of new ‘spatial media’ on the web”. These geospatial platforms, virtual representations of the Earth and other mapping tools are considered to have increased the importance of maps and mapmaking (Crampton 2009; Hudson-Smith et al. 2009b) and geography (Hudson-Smith et al. 2009b), and are used regularly (Crampton 2009). The Geospatial Web, according to Scharl and Tochtermann (2007) can integrate cartographic information (maps and the like) with georeferenced information from data repositories. Parsons (cited in Johnson 2009) however, argues that the focus should not be solely on maps, but ultimately on the geographic information and the attached location attribute. Geographic information can sometimes function as the background, and need not necessarily be the primary focus – for example, a mobile phone application offering train schedules, which are linked to locations (train stations) does not need to provide maps.

3.6.3 Map metaphors and visualisation of non-geographic information

Metaphors have been considered an effective method for interface design (Cartwright 2006) as metaphors provide cognitive models that are familiar to users (Card, Mackinlay and Shneiderman 1999). The use of non-map metaphors to depict geographic information has been explored, especially after the emergence of new technologies that allowed for alternative methods to be considered (Cartwright 1999). Conversely, map metaphors have been applied to depict a range of non-geographic information, ”“spatialized” representations of non-geographic phenomena”, as Cartwright et al. (2001, p. 46) put it. This is because abstract, non-geographic data are
often also structured or connected through a myriad of links, as witnessed in the *renvois* (Zimmer 2009) and Memex (Bush 1945) systems and the hyperlinks that are an integral part of the Web (Weinberger 2002). Maps can give insight into the structure of information and the linkages between the pieces of information (MacEachren and Kraak 2001). Sheppard *et al.* (1999, p. 798) describe these as virtual geographies, as “…the invisible but almost ubiquitous information networks, with their nodes, links, connectivities, and flow, along with the social, cultural, economic, and professional networks that coalesce around the electronic ones”. These “geographies of the information society” (Sheppard *et al.* 1999, p. 798) show locations, connections between them and associated individuals or social groups. Proximity and connectivity between pieces of information (Skupin 2002), and locations within networks are increasingly dominant (Raper *et al.* 2001). This functional distance, Skupin (2000) states, can be mapped like a real geographic distance between two places. The “hyperlinks are the geography of the Web…”, according to Weinberger (2002, p. 49), but notes that distance in the era of the Social Web can be generated by interest rather than function.

Information Visualisation is a branch of the visualisation domain that uses the map metaphor to display non-geographic information (Kraak 2004). Using metaphors, such as maps, as cognitive artefacts can improve the cognitive ability (Card, Mackinlay and Shneiderman 1999). According to Burkhard and Meier (2004), visual metaphors can potentially assist with transfer of knowledge, which may account for the suggestion that “geographic metaphors and cartographic techniques… seem at the heart of so many knowledge domain visualizations” (Skupin 2004, p. 5278). Figure 3.7 is an example of non-geographic information depicted through a geographic metaphor; it shows a business management plan designed using the London Tube Map metaphor.

Considering then also Geovisualization, which “integrates approaches from scientific visualization, to provide theory, methods, and tools for visual exploration, analysis, synthesis, and presentation of geospatial data” (Kraak 2004, p. 85), maps and other geospatial visualisation technologies can be useful methods to explore data that can be geographically or thematically linked. This is because they assist in building knowledge by generating ideas, theories and questions as well as answers (Kraak 2004). Crampton (2009) concurs, adding however that knowledge creation is in the hands of individuals, the users, rather than the providers of the information. Putting this in the context of the
proposed GKT, data’s geographic and thematic connections could be used to visualise data and present ‘knowledge sets’, whilst users could develop their own knowledge through exploration of the map based information provided to them. Furthermore, the temporal aspect of geographic information can “provide the opportunity to analyse the data in order to generate knowledge about behaviour in time and space” (Dykes and Mountain 2003, p. 582).

3.6.4 Collaborative mapping applications and projects

A wide range of applications, projects and activities have applied maps or other geospatial techniques to capture collaboratively contributed geographic information (Bishr and Mantelas 2008) or user generated geo-content (Das and Kraak 2011), or to visualise information and knowledge. Some use Google Earth or other mapping platforms to simply present georeferenced information, whilst others have mapped passively generated UCI to discover patterns in the data. Participation and collaboration is occurring in this geographic realm as amateur mappers create mashups (Hudson-Smith et al. 2009b) and crowdsourcing is applied to capture the collective intelligence. The following sections describe a number of mapping applications and projects that have adopted Web 2.0 concepts and crowdsourcing.

3.6.4.1 OpenStreetMap

OpenStreetMap (OSM) is a collaborative mapping project that uses crowdsourcing to map the world. OSM participants collect data using GPS devices which are then tagged
and uploaded into the OSM map server (Crampton 2009). The project’s main aim is to provide geographic data that are free, both in the economic and usage sense, and on a global scale. OSM has been described as the mapping equivalent of Wikipedia (Johnson 2009).

Since its beginnings in 2004, OSM contributors worldwide have produced UCI, and the data are being utilised online and on mobile phones by millions of people (Ganapati 2009a; Johnson 2009). Users of the data in turn can provide updates during use, further improving the data quality and extent (Ganapati 2009a). There are standards and rules in place that the contributors must adhere to (Hudson-Smith et al. 2009a), however, the data and maps are not yet used by mainstream mapping organisation, although Coast (cited in Johnson 2009) had no doubt that this will occur in the future. Figure 3.8 shows the Melbourne CBD as displayed in OSM.

![Figure 3.8 - Map of Melbourne CBD as viewed in OSM.](Source: www.openstreetmap.org. Accessed 23 September 2009)

### 3.6.4.2 RabbitScan

Briefly mentioned in Chapter 2.3.6, the RabbitScan project was developed for the Invasive Animals Cooperative Research Centre to stimulate community involvement in the mapping of occurrences and impacts of rabbits in their local area (Quealy 2009).
Participants could either send an email or text message with their information or they could plot it on a *Google Map* with tools designed for the project. RabbitScan used so-called ‘citizen science’ to capitalise “on the enthusiasm of people to get involved in natural resource issues by collecting data required for scientists...” (Spatial Vision 2012, para. 4). The combined individual contributions produced a nationwide map of the location of rabbits and their impact on the environment. The initial 2009 RabbitScan project has evolved into an application that provides Web based mapping tools for people to use (FeralScan 2011). Apart from rabbits, the organisation is now also asking the public to record sightings of other pest animals including feral pigs, camels and foxes. Figure 3.9 is a screenshot of the new RabbitScan Web mapping tool.

![RabbitScan Web mapping tool](https://www.feralscan.org.au/rabbitscan/map.aspx)

Figure 3.9 - Screenshot of the current RabbitScan Web mapping tool.  

### 3.6.4.3 Real Time Rome

The Real Time Rome project undertaken by the Massachusetts Institute of Technology (MIT) mapped passively generated UCI to give insight into the movement of people in real time (SENSEable City Lab 2006). In collaboration with an Italian telecom company, the 2006 project used data generated by cell phone users as they went about their business. Combined with data from buses and taxis, a series of maps of Rome, Italy were produced. The maps depicted information about urban movement in Rome in
real-time such as congestion spots in the city at particular times – information potentially useful for planning or traffic management decision-making. Figure 3.10 shows the number of people visiting Rome’s major tourist sites at a particular point in time.

Figure 3.10 - Map depicting visitors to Rome’s major tourist sites.
(Source: SENSEable City Lab, senseable.mit.edu/realtimerome/. Accessed 23 September 2009)

3.6.4.4 ‘Digital Footprinting’

Location based information can be most useful, and mobile communication devices in particular have the potential to capture considerable amounts of UCI that have both spatial and temporal characteristics (Dykes and Mountain 2003). According to Girardin et al. (2008, p. 36), personal mobile devices “create a vast, geographically aware sensor web that accumulates tracks to reveal both individual and social behaviors with unprecedented detail”. Researchers from the Spanish University Universitat Pompeu Fabra and MIT utilised UCI from mobile phone networks together with georeferenced photographs produced with the devices to analyse the movement of tourists through Rome. Both a spatial and temporal presence could be determined from the “digital footprints” (Girardin et al. 2008, p. 38). Using Google Earth to overlay the results, the
researchers envisaged that the spatio-temporal data can potentially assist in a better understanding of tourist movements (Girardin et al. 2008), and the results can be applied accordingly.

3.6.4.5 Real-time traffic applications

The real-time data that mobile devices can produce, as illustrated in the previous two projects, have also been applied for traffic purposes. Google Maps introduced the option to view real-time traffic information on its maps, with the mobile application increasingly being used by drivers (AAP 2009). The real-time data is obtained from drivers and supplied by Intelematics Australia. Other motorists can add their own data – real-time location and speed – through their mobile phones, thus enhancing the overall traffic picture. The real-time traffic information is currently available in a few countries only, including major cities in Australia. Figure 3.11 depicts a screenshot of Google Maps with real-time traffic flows in Melbourne using a traffic light-like colour coding.

Figure 3.11 - Screenshot of Google Maps showing traffic conditions in real-time in Melbourne.
Nokia trialled a similar approach for real-time traffic in California, stating that “it believes a community of users with GPS-equipped mobile devices can help reduce traffic by enabling drivers to make better decisions” (Ganapati 2009b). The company TomTom goes a step further and uses the community of users of its mobile navigation devices to improve the map data that it provides. The TomTom MapShare technology allows users to make changes to the map, which include reversing travel directions on a street, naming or renaming a street, and adding, removing or renaming a point of interest (TomTom n.d.). This in turn can be fed into the TomTom system and shared with other users, thus improving the overall spatial database.

3.6.4.6 Applications using georeferenced images

People contributing images to the photo-sharing site Flickr can georeference their photographs. As at 02 February 2012, there are over 174 million geotagged images on the site. Flickr has made these accessible using a map of the world – Figure 3.12 showing images for The Netherlands. Various projects are using the geotagged images on Flickr for different reasons. A Yahoo project for example has analysed these images to create travel guides for tourists (Simonite 2010), whilst Crandall et al. (2009) are discovering ways to organise the photographs through their project Mapping the World’s Photos.

Figure 3.12 - Flickr screenshot depicting georeferenced images relevant to The Netherlands. (Source: Yahoo!, www.flickr.com/map/. Accessed 10 December 2009)
3.6.4.7 Other applications

The projects and applications described are just some examples of how georeferenced UCI are being visualised using maps. There are many others such as the real-time mapping of yellow taxis (cabs) in San Francisco, USA, in the Cabspotting project\textsuperscript{47}; the Amsterdam RealTime\textsuperscript{48} project developed by the Dutch organisation Waag Society that used GPS devices to visualise people’s mental maps as they moved through the city; and the English BBC Look East Credit Crunch\textsuperscript{49} project. This project applied crowdsourcing to map the effect of the financial crisis on a portion of the British population utilising MapTube\textsuperscript{50} mapping software. Users of eBird\textsuperscript{51}, mentioned previously in Chapter 2.3.6, can use charts, graphs and Google Maps to view and explore data. And finally, like OSM, Google has recognised that users can enhance its maps and often possess local knowledge that the company's own staff does not. Google introduced Google Map Maker\textsuperscript{52} in 2008 (Mitchell 2011), a crowdsourcing tool that allows people to make changes to the existing Google Maps or Google Earth maps. These changes, after having been reviewed and approved, are applied to the live applications. To date, more than 188 countries and regions are available for such edits (Google 2012).

3.7 Chapter summary

The purpose of this chapter, like the previous Chapter 2, was to provide a theoretical foundation for the proposed GKT. The chapter broadly provided an overview of aspects of different knowledge systems to finish with opportunities for a collaborative, geographically oriented knowledge system that recent Web developments have made possible – in line with the proposed GKT.

The chapter commenced with an exploration of what knowledge is using the DIKW model and explained different types of knowledge. It also discussed how knowledge could be captured, describing Nonaka and Konno’s (1998) SECI model and the storytelling method as examples. The ensuing sections outlined the essence of

\textsuperscript{47} Refer cabspotting.org/index.html.
\textsuperscript{48} Refer www.waag.org/project/realtime.
\textsuperscript{49} Refer www.bbc.co.uk/lookeast/content/credit_crunch/credit_feature.shtml.
\textsuperscript{50} MapTube is a software tool developed by University College London’s Centre for Advanced Spatial Analysis. It is a free mapping tool to create mashups and the like and can be downloaded free of charge (Centre for Advanced Spatial Analysis 2009) -www.maptube.org.
\textsuperscript{51} Refer ebird.org.
\textsuperscript{52} Refer www.google.com/mapmaker.
knowledge systems and how they might have developed. Data classification was deemed an important aspect of information retrieval and was similarly regarded to be a key to effective knowledge systems. Different classification systems were described; from traditional hierarchical and alphabetical classifications to faceted classifications that allow for data with multiple attributes, that can not simply be structured in one way, to be classified or organised according to different perspectives. An example of Parks Victoria data showed that the organisation’s data are generally multi-faceted. In order for the GKT to find and present relevant data, alternative classifications that allow for multiple classification structures seemed useful so the same data become findable by people with different purposes.

The section then moved to knowledge systems based on hypertext – describing the renvois, Memex and hypertext itself in more detail – and geographically oriented knowledge systems, using Al Gore’s (1998) Digital Earth as an example. It finished with brief discussions on databases and AI, because of their association with knowledge systems in general.

The Web was regarded as a knowledge system itself, and was discussed in the next section, focussing on the dissemination of knowledge on the Web through interaction and information sharing, and the organisation of data using hyperlinks. With the arrival of Web 2.0, the original Web became collaborative, and collaborative knowledge systems were thus the next phase. It was discussed how Web 2.0 tools are increasingly being applied by organisations – making the management and organisation of information and knowledge a team effort. KM was an area where such tools are applied. The topic of KM was explored further, which included the development of top-down versus bottom-up organisations and how a collaborative approach can affect decision-making processes by asking customers for input for example, as Dell has done. Enterprise 2.0 was also discussed in more detail, and examples of knowledge sharing between different organisations were provided including within the park management realm. Parks Victoria aims to share knowledge in different ways, and the organisation was regarded to be taking some steps towards being an Enterprise 2.0 company.

The final phase in knowledge systems was the addition of location to collaborative knowledge systems. The proposed GKT would provide access to digital data that are geographically linked. The next section therefore focussed on geographic information in general, and discussed how geographical visualisation techniques including maps
could be applied effectively to not only present geographic information, but also non-geographic data that are thematically linked – like Parks Victoria’s data.

The final section described examples of projects and applications that use crowdsourcing and geographic visualisations techniques. Their purpose was to get a better understanding of what potential opportunities exist. The range of projects described have attested to the rationale of the research project and the question if alternative data – UCI and information available on the Web and not traditionally considered by Parks Victoria – could potentially benefit the organisation's existing data archive. Some of the examples, together with the examples listed in Chapter 2.3.6, showed that non-traditional data sources might potentially fill information gaps and subsequently enhance knowledge.

The next chapter – Park Management, Parks and Park Data – concludes the background review to the research project. Parks Victoria being a park management organisation, the chapter discusses aspects of parks and park management, commencing with a general overview of park management, its history and parks in Australia. The focus then shifts to parks in Victoria in general, including broad legislation that applies, before moving to Parks Victoria as an organisation. A number of topics are discussed including the organisation’s structure, park management goals and planning, and information systems currently in place. The chapter concludes with examples of methods of data provision and capture in parks at Parks Victoria and elsewhere. The purpose of the chapter is to provide insight into park management in general, and Parks Victoria as an organisation, to be applied to or considered for the proposed GKT.
Chapter 4. Park Management, Parks and Park Data
4.1 Chapter overview

As outlined in the Introduction chapter, Parks Victoria manages parks on behalf of the Victorian State Government, and the organisation was a collaborator on the research project. It was Parks Victoria’s data archive that was considered not to be used as effectively as it potentially could be, which was a catalyst for beginning this research. Parks Victoria’s existing data formed the basis for the methodology for a GKT developed for the research project, whereas the case study and demonstration prototype focussed on one park and a portion of the organisation’s data.

The purpose of this chapter is to complete the theoretical foundation of the research by focusing on a third broad area: parks and park management. Following chapters on Web 2.0 and knowledge systems, this chapter discusses aspects of park management and Parks Victoria as an organisation (the ensuing chapter describes the case study in detail). The aim is to provide background information for the general area of park management and insight into the organisation, to assist in developing the theoretical methodology for the GKT, the case study and demonstration prototype.

The chapter firstly provides a general overview of park management, and identifies different categories of parks, so-called protected areas. This is followed by a discussion on the history of the national park movement that commenced in the United States, before discussing park management in Australia in general. Next, an overview of parks in Victoria is described, and the main legislation applicable to park management in the State is listed. The focus then shifts to Parks Victoria as an organisation. The organisational structure, management areas, goals and strategy are discussed, whilst the ensuing section describes information systems currently in place. Next, the collaborative practices of Parks Victoria are briefly examined, and how the organisation aims to involve the community in the management of its parks. The chapter concludes with examples of methods of provision and capture of park related data, both at Parks Victoria and elsewhere.

4.2 Protected areas and park management

National parks and other natural areas fall under the umbrella term ‘protected areas’. A protected area is defined by the International Union for Conservation of Nature (IUCN) as “A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with
associated ecosystem services and cultural values” (Dudley 2008, p. 8). The IUCN is a world body founded in 1948 with the overall aim of conserving nature and biodiversity, and ensuring equitable and ecologically sustainable use of natural resources. It consists of over 1000 members from 160 countries including government, state and non-government organisations. The protected areas in the world currently cover around 12% of the Earth’s land surface (Dudley 2008).

The characteristics of protected areas vary enormously, and range from areas with predominantly mountains or glaciers, tropical rainforests, lakes and plains to volcanic islands or ancient monuments (Worboys, Lockwood and De Lacy 2005). Recognising that different areas have different management purposes and needs, the IUCN derived six management categories that serve as a global framework. These six categories are:

- Category Ia - Strict nature reserve (managed mainly for science);
- Category Ib - Wilderness area (managed mainly for wilderness protection);
- Category II - National park (managed mainly for ecosystem conservation and recreation);
- Category III - Natural monument or feature (managed for conservation of specific natural features);
- Category IV - Habitat/species management area (managed mainly for conservation through management intervention);
- Category V - Protected landscape/seascape (managed mainly for landscape/seascape conservation and recreation); and
- Category VI - Protected area with sustainable use of natural resources (managed mainly for the sustainable use of natural ecosystems) (IUCN 1994).

The IUCN protected area categories are applied by a growing number of international bodies and governments, and are regarded as the international standard for defining protected areas that is comparable and understood by all countries (Dudley 2008). Accompanying guidelines assist park managers in managing protected areas suitable to their purpose and in appropriate ways to reach the proposed outcomes.

Parks, and their management, are important for a number of reasons. Besides the perhaps obvious environmental advantages, parks also have social and economic benefits (Parks Victoria 2005). The environmental advantages of natural areas include
the protection of flora and fauna and the preservation of biodiversity and ecosystems. From a social perspective, parks deliver recreational opportunities but research has shown that parks can enhance psychological well-being, promote learning, self-development and community involvement and generally provide mental and spiritual health (International Parks Strategic Partners 2004). Finally, the economic benefits of parks relate to, for instance, tourism and employment in associated areas and services.

4.2.1 Brief history of park management

The modern national park movement started in the United States of America (Allin 1990). Although the US Government ordered Hot Springs, in the current state of Arkansas, to be set aside in 1832 as a national reserve, the reason for doing so was to preserve the hot springs – believed to have medicinal powers – rather than to preserve the environmental scenery (Ise 1979). Yosemite Valley was set aside as a state park in 1864, and it is thus Yellowstone National Park that is generally regarded as the first national park, established in 1872. Australia followed soon after. In 1879, aptly named National Park near Sydney (now Royal National Park) became Australia’s first national park. It was managed more like a recreation park however, and included ornamental gardens, a zoo and areas for recreational activities like cricket and swimming (Worboys, Lockwood and De Lacy 2005). In Victoria, Tower Hill near Warrnambool was reserved as a public park in 1866, and declared a National Park in 1892, followed six years later by Mount Buffalo National Park and WPNP.

The USA was the first country to have a national park policy, later applied and adapted by various other countries (Ise 1979). Early park managers looked at national parks as “isolated islands of naturalness distinct from civilization or human culture” (Allin 1990, p. 1). It was later recognised that what happens inside and outside park boundaries is connected, and that the impacts of economic and technological advances and population growth for instance in turn affect the environment. However, this also meant that not all governments necessarily put park management as a priority issue because the land was regarded as more useful for purposes other than conservation ones. Subsequently, the protected areas management framework derived by the IUCN still seeks to protect

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53 The notion of ‘modern’ park management is applied because it is argued that the ideas of conservation and protection of natural areas existed far earlier than this, and originates for example in Australia with the Aboriginal people. These first Australians up until today maintain a deep respect for the land that includes the protection of certain land and flora and fauna species (Worboys, Lockwood and De Lacy 2005).
nature, but has at the same time provided room for economic and social needs (Wright 1996).

### 4.2.2 Parks in Australia

There are over 9300 protected areas in Australia, which cover more than 98 million hectares and combined account for more than 12% of the country’s land area (Director of National Parks 2011a). Australia’s first park management agency, the National Parks Service, was established in 1956 (International Parks Strategic Partners 2004).

Currently, Parks Australia is the Commonwealth agency that works with the federal Minister of the Department of the Sustainability, Environment, Water, Population and Communities to maintain and protect biodiversity and the coupled cultural legacy for the natural areas that fall under its management (Director of National Parks 2011a).

Three broad categories of parks exist: urban, regional and national (International Parks Strategic Partners 2004). In Australia, most of these are managed by state or territory agencies (Director of National Parks 2011a) such as Parks Victoria, New South Wales Parks and Wildlife Services and Tasmania Parks and Wildlife Services. Several other parks and reserves are managed by Indigenous land owners, local governments and private landholders (Director of National Parks 2011b). Table 4.1 shows the number of protected areas managed by the different groups in Australia at present.

<table>
<thead>
<tr>
<th>Governance</th>
<th>Number of protected areas</th>
<th>Total area (ha)</th>
<th>Proportion of total protected area</th>
<th>Per cent of Australia</th>
<th>Average size (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>6,983</td>
<td>64,209,305</td>
<td>65.20%</td>
<td>8.35%</td>
<td>9,194</td>
</tr>
<tr>
<td>Indigenous</td>
<td>24</td>
<td>20,533,879</td>
<td>20.85%</td>
<td>2.67%</td>
<td>855,578</td>
</tr>
<tr>
<td>Local Governments</td>
<td>132</td>
<td>9,590,523</td>
<td>9.74%</td>
<td>1.25%</td>
<td>72655</td>
</tr>
<tr>
<td>Private</td>
<td>2201</td>
<td>4,153,409</td>
<td>4.22%</td>
<td>0.54%</td>
<td>1,887</td>
</tr>
<tr>
<td>Grand Total</td>
<td>9,340</td>
<td>98,487,116</td>
<td>100%</td>
<td>12.81%</td>
<td>10,544</td>
</tr>
</tbody>
</table>

Table 4.1 - Ownership of protected areas in Australia.
(Source: Director of National Parks 2011b)
Parks Australia also manages a number of national parks, gardens and reserves around Australia, as well as marine protected areas. These include Kakadu National Park, Uluru – Kata Tutja National Park, the national parks on Christmas Island and Norfolk Island and biosphere reserves spread throughout the country including the remote World Heritage Area of Macquarie Island. Figure 4.1 and Figure 4.2\textsuperscript{54} show the division of protected land within each state (as a percentage of the total area in Australia) and the actual number of parks and reserves in each individual state or territory respectively.

Figure 4.1 - Protected areas within each state as a percentage of the total protected area in Australia.

Figure 4.2 - The number of parks and reserves within each state.

(Source: Director of National Parks 2011b)

The National Reserve System (NRS) is a cross-state and agency network of protected areas. The network aims to conserve examples of Australia’s natural landscapes and native plants and animals. Based on a scientific framework, it is “the nation’s natural safety net against our biggest environmental challenges” (Director of National Parks 2011a, para. 1). The strategic framework \textit{Strategy for Australia’s National Reserve System 2009-2030} intends to ensure that the role of the NRS is maintained, and

\textsuperscript{54} The abbreviations for state names used in the two figures represent – starting with WA going in a clockwise direction – Western Australia, Australian Capital Territory, New South Wales, Northern Territory, Queensland, South Australia, Tasmania and Victoria.
simultaneously highlights the environmental importance of protecting biodiversity and ecosystems (National Reserve System Task Group 2009).

NRS protected areas under private ownership and those managed by local governments have the potential to be valuable assets in maintaining Australia’s biodiversity (Director of National Parks 2011b). Natural resource management being most successful if considered from a whole of landscape approach (Fitzsimons and Wescott 2001), to strengthen the NRS, the current federal environmental program Caring for our Country provides guidelines to assist in purchasing new reserves to be added to the NRS and support private landowners, including farmers, to protect (part of) their land for the purpose of conservation (Commonwealth of Australia 2008).

4.3 Parks in Victoria

Victoria contains a diverse range of natural areas that require managing, comprising a broad range of ecosystems varying from “alpine to semi-arid, from coastal environments to temperate rainforests and rolling grasslands” (Department of Sustainability and Environment 2009b, para. 5). The previous Figure 4.1 and Figure 4.2 show that although the total area of Victorian parks is only 4% of the total cover of protected areas, more than 30% (2,971 out of 9,340) of all Australian parks are in Victoria. Parks Victoria, Indigenous and private landowners, and local councils generally manage these natural areas.

Parks Victoria manages a large number on behalf of the Victorian Government with representatives of all different types of natural habitats present in the state included in the organisation’s estate (Department of Sustainability and Environment 2009b). Figure 4.3 is a map of Victoria that shows parks and other public lands under the organisation’s management.

Apart from terrestrial parks, Parks Victoria manages marine parks and looks after the recreational management of Port Phillip Bay, Westernport and Port Campbell and the Yarra and the Maribyrnong rivers (Parks Victoria 2011g). The approximate area that

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This should be put into context somewhat, as the area of Victoria only covers about 3% of the whole of Australia (Geoscience Australia 2010). Because of the large number of individual parks in Victoria, their average size is the smallest compared to those of other states. The average size of Victorian parks is around 1,321 ha, whereas the national average size is 10,543. The average park size in the Northern Territory, the largest, is 126,272 ha (Director of National Parks 2011b).
Figure 4.3 - Parks Victoria regions and districts, depicting the location of parks, reserves and other public land in Victoria.

(Source and copyright: Parks Victoria 2012. Used with permission)
these natural areas cover is over 4 million hectares, or about 18% of the state of Victoria. Table 4.2 shows the variety of parks included in Parks Victoria’s estate.

<table>
<thead>
<tr>
<th>Type of Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 National parks</td>
</tr>
<tr>
<td>13 Marine national parks</td>
</tr>
<tr>
<td>25 State parks</td>
</tr>
<tr>
<td>11 Marine sanctuaries</td>
</tr>
<tr>
<td>3 Wilderness parks</td>
</tr>
<tr>
<td>30 Metropolitan parks</td>
</tr>
<tr>
<td>&gt; 2700 natural features and conversation reserves</td>
</tr>
<tr>
<td>&gt; 11,000 Aboriginal cultural heritage places (formally registered)</td>
</tr>
<tr>
<td>&gt; 2,500 non-Indigenous historic places</td>
</tr>
<tr>
<td>60 Other parks (these include regional and reservoir parks)</td>
</tr>
</tbody>
</table>

Table 4.2 - Variety of parks under Parks Victoria management.
(Source: Parks Victoria 2011g, p. 6)

The aforementioned benefits of parks also apply to Victorian parks, and Parks Victoria manages parks accordingly. The primary role of parks is to protect native flora and fauna species, vegetation communities, wetlands needed for migratory birds, and natural biodiversity (Parks Victoria 2007). Parks also play a key role in protecting Victoria’s water supply and catchment areas, preserve cultural and historic sites and landscapes, and provide for outdoor recreation of all types thus playing an important role in community and individual wellbeing – encapsulated in the Healthy Parks Healthy People slogan (Parks Victoria 2011d). Finally, parks benefit Victoria economically (Parks Victoria 2007). Tourism Victoria (2008) reports that the national parks in Victoria, managed by Parks Victoria, have the highest number of visitors in the country. Approximately 88.5 million people visit parks and waterways in the State every year (Parks Victoria 2011b), and “the [Victorian] park system is estimated to contribute some $A960 million annually to the Victorian economy” (International Parks Strategic Partners 2004, p. 17).

It is up to other land managers – Indigenous and private landowners, and local councils – whether their private lands are managed for conservation purposes. Fitzsimons and
Westcott (2001, p. 142) identify three types of such “private conservation properties”: 1) Reserves owned and managed by the Trust for Nature (Victoria); 2) Private properties with a Trust for Nature Conservation Covenant attached to the title; and 3) Private properties with a Land for Wildlife program accreditation”. Victoria’s Trust for Nature, through its Conservation Covenant program, is now protecting over 1088 private properties since its start in 1987, which covers over 45,000 hectares of the State’s land (Trust for Nature 2012).

The approach for the management of protected areas on Indigenous land differs. The Indigenous Partnership Framework (Department of Sustainability and Environment 2007) is a means to work together with Indigenous landholders to achieve similar goals as those attained with private landholders, under the management goal for cultural heritage, land and water. The Environment Protection and Biodiversity Conservation Act 1999 (Cth) ensures that “the significance of Indigenous peoples’ knowledge of land management, conservation and sustainable use of biodiversity” is recognised in the management of the land (Indigenous Land Corporation n.d., p. 15). For example, a Cooperative Management Agreement established in 2004 means the Yorta Yorta Nations Aboriginal Corporation and the Victorian Government jointly advise and manage areas within Yorta Yorta Country that includes Barmah National Park (Wolcott 2009), included in Parks Victoria’s estate.

4.3.1 Legislative framework

Two key pieces of legislation applicable to the management of parks by Parks Victoria are the National Parks Act 1975 (Vic) and the Crown Land Reserves Act 1978 (Vic) (Parks Victoria 2004, 2007). The National Parks Act 1975 (Vic) covers national parks, wilderness parks, state parks, marine sanctuaries and marine national parks, as well as other parks and reserves. The Crown Land Reserves Act 1978 (Vic) gives guidelines for the management of different reserves, metropolitan, regional and reservoir parks, and historic areas and reserves (Parks Victoria 2004). The Acts outline the management goals for the different types of parks. For instance, “National and State parks are managed primarily for the protection of natural values [whilst] Metropolitan parks… are managed primarily for recreation and open space values” (Parks Victoria 2004, p. 6), although environmental and cultural values are also preserved.
Parks Victoria’s responsibility for managing parks and other natural areas in the State on behalf of the Government is detailed in the *Parks Victoria Act* 1998, and outlined in a Management Services Agreement (Parks Victoria 2009a). Other Victorian legislation applicable to the management of the organisation’s estate include the *Port Services Act*, the *Aboriginal Heritage Act* 1996, the *Flora and Fauna Guarantee Act* 1988, the *Forests Act* 1958, the *Heritage Act* 1995, and the more recent *Traditional Owner Settlement Act* 2010 (Parks Victoria n.d.-d). Important federal legislation includes the *Environment Protection and Biodiversity Conservation Act* 1999, the *Native Title Act* 1993, and the *Aboriginal and Torres Strait Islander Heritage Protection Act* 1984.

Land managed by private land owners is generally covered by legislation through the inclusion of a ‘duty of care’ clause in some of these Acts (Australian Conservation Foundation 2005) such as the *Flora and Fauna Guarantee Act* 1988 and the *Environment Protection and Biodiversity Conservation Act* 1999 (Department of Sustainability and Environment 2012). Planning regulation further requires landowners to adhere to certain rules, whereas the *Catchment and Land Protection Act* 1994 confirms the duty of care of landowners with regard to land degradation, soil conservation and the protection of water resources amongst others issues.

Apart from legislation specific to the management of parks (from an environmental perspective), legislation particular to Parks Victoria as a government organisation also applies. As a public authority for instance, the organisation’s duties and obligations with regards to information management are encompassed by a range of Acts and other regulations including the *Victorian Public Records Act* 1973, the *Freedom of Information Act*, the *Information Privacy Act* and the Victorian Electronic Records Strategy (Parks Victoria 2011e).

Many other legislation, policies, codes of practice and agreements at a state, national and international level have to be taken into consideration or adhered to for the management of parks (Parks Victoria n.d.-f). A summary of these, available from the Parks Victoria website, is viewable in Appendix II.
4.4 Parks Victoria

Parks Victoria was founded in 1996 through an amalgamation of Melbourne Parks and Waterways and Victoria’s National Parks Service (Parks Victoria 2007). A statutory authority that works with the Department of Sustainability and Environment (DSE), Parks Victoria provides strategic policy advice and reports to the appropriate Minister (at time of writing the Minister for Environment and Climate Change) of the Victorian Government on the operations of park management (Department of Sustainability and Environment 2011c).

Parks Victoria’s responsibility is to manage Victoria’s natural assets including parks and reserves, waterways and bays and other public land (Parks Victoria 2007). It does so in accordance with the National Parks Act 1975 and other legislation referred to previously. The National Parks Act 1975 provides the “statutory basis for the protection, use and management of …[Victoria’s] system of national and other parks…” (Department of Sustainability and Environment 2011c, p. 1). The priorities for the park estate are detailed in a Management Services Agreement, which is agreed between DSE and Parks Victoria and is reviewed every three years. As previously mentioned, the organisation’s estate comprises about 18% of Victoria’s land area and about 70% of its coastline (Parks Victoria 2011g). As a result, Parks Victoria is also responsible for over 25,000 related assets including visitor centres, piers and jetties, roads and bridges, and playgrounds, toilets and shelters.

4.4.1 Organisational structure

At the top of Parks Victoria’s organisational structure is The Board, ultimately being "responsible for all matters relating to the running of Parks Victoria” (Parks Victoria 2008a, p. 5). The Board is the representative of, or acts on behalf of, the Minister and the State Government in overseeing the business operations of Parks Victoria. The day-to-day affairs are the responsibility of The Office of the Chief Executive, consisting of the Chief Executive and an executive team. A number of committees have advisory roles and assist The Board on a range of issues (Parks Victoria 2011g).
The organisation until recently comprised six\textsuperscript{56} main management divisions (Parks Victoria 2011g), but restructured this in late 2011 to four (Parks Victoria 2011h). The Executive Team comprises General Managers of the four new management divisions: Corporate Services; Environmental and Heritage; Visitors and Community; and Regions. The divisions have a statewide role to provide services and functional expertise in their respective fields (Parks Victoria 2012b).

Divisions in turn generally comprise a number of departments or teams that are hierarchically structured with one or two levels of managers, a team leader or supervisor, senior staff and other staff. The Regions Division is made up of five regions – Central, East, Melbourne, West, and the Bays and Maritime Region – which are divided into districts covering different parks. A Chief Ranger is in charge of a district, whereas a Ranger in Charge manages an individual park.

From a geographic perspective, Parks Victoria is a geographically distributed organisation. It has a centrally located Head Office, in the Melbourne CBD, and various divisional, regional, and district management offices throughout Melbourne and Victoria. The broadest geographic divisions, apart from the whole park network, are the five management regions (Central, East, Melbourne, West, and Bays and Maritime) and their districts. Moving to a micro level sees individual parks, areas and divisions within parks, down to specific geographic locations more or less definable by geographic coordinates.

Figure 4.4 represents the broad, geographical hierarchy that exists at Parks Victoria, with WPNP used for the example on the right.

As at June 2011, Parks Victoria employed over 1100 full-time, part-time and casual staff that operates throughout the state. Out of those around 320 rangers and another 186 field staff were involved in actively managing lands in accordance with the National Parks Act 1975 and other legislation (Department of Sustainability and Environment 2011c). The organisation employs people from a variety of professional areas including natural resource, cultural and heritage management; human resources, marketing, tourism, engineering and statutory planning (Parks Victoria n.d.-c).

\textsuperscript{56} The previous six management divisions comprised: Regional Management, Commercial Business, Corporate Strategy & Services, Parks, Bays & Maritime, and Sustainable Infrastructure (Parks Victoria 2011g)
In order to fulfil its responsibility, Parks Victoria has a mission “to protect and improve Victoria’s parks and waterways for people forever” (Parks Victoria 2011b, p. 6). To realise this, the organisation’s purpose is to “conserve, protect and enhance Victoria’s environmental and cultural assets, as well as provide information, services and experiences for visitors to parks which contribute to the social and economic well-being of all Victorians” (Parks Victoria 2007, p. 2).

To provide social, economic and environmental benefits, the focus is on four main areas of work, each covering a range of management issues:

- **Natural Values Management (NVM);**
- **Visitor Services;**
- **Cultural Values Management (Indigenous and post-settlement);** and
- **Fire and Emergency Management (Votar Partners Pty Ltd 2008).**

The four areas are supported by two other management areas: Organisational Performance and Commercial Business (Parks Victoria 2011g; Votar Partners Pty Ltd 2008).

Parks Victoria has devised a management framework to help it achieve its long-term goal, with guidelines adopted as set out by the IUCN (Parks Victoria 2007) (discussed

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57 As at 01 February 2012, these four areas still apply. However, Parks Victoria was at the time of writing in the process of evaluating a range of issues, including its future directions. A draft Corporate Plan shows five new areas of focus: Environment, Land and Water; Culture and Heritage; Visitors and Community; Fire and Emergency; and A Sustainable Organisation (Parks Victoria 2011h).
earlier in this chapter). It draws on the Management Effectiveness Model supported by the World Commission of Protected Areas as well as its own Environmental Management Framework (EMF) (Votar Partners Pty Ltd 2008). Furthermore, it applies techniques and practices already in place in the parks that have been proven successful (Parks Victoria 2007).

4.4.3 Park management strategy

The essence of Parks Victoria’s management strategy centres on the areas of knowledge, planning and evaluation.

Knowledge “combined with legislative and policy directions forms the basis for clear, long-term strategies to achieve the best possible outcomes for Victoria’s parks and reserves” (Parks Victoria 2007, p. 2). Specific research is undertaken – including collaborative research programs in conjunction with some major research institutions – to increase Parks Victoria’s knowledge of how to manage natural values, and to gain a better understanding of cultural values and information about its visitors (Parks Victoria 2007).

The State of the Parks program is an important management tool that is utilised by agencies like Parks Victoria to improve the management of their parks (Parks Victoria 2007). The report gives assessments of the current conditions of natural, cultural, recreational and economic values. Furthermore, it enables the evaluation of the effectiveness of various management programs in place, advises where improvements are possible and emphasises problem areas. It is therefore useful for setting goals and prioritising tasks, and assists in appropriate management actions and decisions.

The second component of Parks Victoria’s strategy for effective park management is planning. Each park has a management plan that requests community input and feedback, and is reviewed every 15 years. Five year implementation plans and annual action plans derived from the management plans detail more specific strategies and actions to be taken. A number of internal tools are available to assist planning activities and decision-making such as the Levels of Service framework, the Levels of Protection tool, and the Signs of Healthy Parks monitoring program (Parks Victoria n.d.-e).

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58 As part of the organisational review underway at time of writing, a new structure will focus on three different areas: 1) planning, programming and monitoring; 2) delivering services and works; and 3) a sustainable organisation (Parks Victoria 2011h).
The internal planning structure runs from strategic to operational. The organisation’s (current) long-term vision and associated goals are captured in the *Parks Victoria - People, plans and places 2011 – 2012* report. Corporate plans, framed within existing legislation and guidelines, describe three year strategies and goals whilst annual business plans outline what is to be achieved in a particular year (Parks Victoria 2011a). Moving from the strategic to the operational, the strategic corporate and business plans in turn provide the framework for regional and divisional action plans as well as individual work plans (Parks Victoria 2012b).

The third component of the management strategy is evaluation. Special targeted monitoring systems are in place to identify changes over time, and to assess the effectiveness of practices and programs in place. Systems are continuously improved through the incorporation of local knowledge, enabling Parks Victoria to amend its practices and programs as required, as part of an adaptive management approach. The prescribed ecological burn used for the case study component of the research (described in more detail in Chapter 5.7) for instance, was part of an adaptive experimental management project. Data was specifically collected during pre and post burn monitoring to learn from and to apply to future burns (J Whelan 2011, pers. comm. 07 April).

The progress of actions outlined in the annual business plans is reported back to the State Government, and can thus be evaluated at the same time, through midyear and end-of-year review procedures (Parks Victoria 2010b)

### 4.4.4 Current information systems and access to data

A number of information systems are in place for staff to find and access data and information. Some are relevant to specific management activities, and access to such system can be restricted to appropriate staff only. Some systems provide identical information as they draw from the same databases. An SQL server and an Oracle database comprise the main two databases for textual and spatial information (Business Systems Strategy Working Group 2008; Parks Victoria n.d.-a).

Key information systems that are currently in use are:
- **InfoWeb** – Parks Victoria’s Intranet that provides access to most organisational data and information. This can be in the form of information in the system itself, a link to other documents, or an access link to the other information systems;

- **Parks and Reserves Information Management System (PRIMS)** – textual, view only system maintained by DSE and updated at least yearly. PRIMS contains management, policy and legislative information about the parks and reserves managed by Parks Victoria (the only details passed on by DSE) (Business Information Systems 2009). The information is viewable in map form through a quick link to the ParkView system (see below). PRIMS is the ‘single point of truth’, that is, the primary source for any information relating to the organisation’s estate and as such is utilised in a number of applications. When a new PRIMS version arrives from DSE, various systems are updated including ParkView, Info Centre and the Stakeholder Database;

- **PVWeb** – New Intranet based on Microsoft *SharePoint* software. It is a test site only to evaluate the effectiveness of *Sharepoint* as a tool for collaboration. Not all staff have access to PVWeb and the data published on the site are largely accessible via other systems. The site is primarily organised by teams, with each team section containing a wiki and the ability to add other collaborative tools as required. Members of the teams can create or modify the tools (depending on restrictions put in place). As at 11 June 2012, it is unsure if PVWeb will ultimately replace InfoWeb;

- **Info Centre** – information database that contains general information on parks and features within parks, and is primarily used by staff to answer questions by the public. Details contained include contact details, location, entry fees, payment methods, opening hours, closures, events, activities and facilities;

- **Total Records and Information Management (TRIM)** – system for the management of electronic official documents (see below for further details);

- **ParkView** – an interactive map based information system (see below for further details);

- **Asset Information System (AIS)** – comprises all Parks Victoria assets, with spatial data housed in the Oracle database and textual data in the SQL server. The data are maintained by the Asset System Administrator through an annual validation process (described later in section 4.5.3), and through data updates submitted by staff. Staff access this information through the Asset Management Module in ParkView (Parks Victoria n.d.-a); and
Environmental Information System (EIS) – spatial application designed to support NVM to assist with capturing, accessing and reporting on NVM related information by location. EIS was, and still is, to be phased out and replaced by ParkView at a yet to be determined date in the future (B Crocker 2012, pers. comm. 08 February).

Two information systems managed by DSE – accessible through the DSE website or via a shortcut on InfoWeb – used by Parks Victoria staff are:

- Firemap – comprises an interactive Web based mapping application, with planned fire related data layers that assist with fire management activities; and
- FireWeb – consists of an interactive Web mapping application for fire operation planning.

Parks Victoria information systems with restricted user access are:

- Infosafe – an online chemical management system;
- Fleat and Leased Equipment Asset Tracking system; and
- Tenancy – contains information about leases and licenses.

Other corporate systems in place include the Finance and People system for staff and human resources information, the Corporate Directory for communication needs, the Stakeholder Database with information about Parks Victoria’s stakeholders; and the Tour Operator Management System for information specific to tour operators licensed to operate within the parks. Most information systems listed, with the exception of PVWeb, AIS and EIS, are accessible via InfoWeb.

Apart from the official databases in use, data are also stored on computer drives. Broadly, there are two corporate drives (S and O) for groups – teams, departments project groups – to store data and the drives are structured accordingly. GIS data (for use in the GIS software MapInfo) and imagery are stored on the H and M drives respectively, whereas the I-drive is for personal file storage.

Finally, Parks Victoria’s external website provides access to a range of information, although most staff will also be able to source this information internally. The interface of the site was overhauled in 2011 and, in line with Web 2.0, instead of just providing information to the public, visitors to the site can contribute information such as photos.

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59 Refer parkweb.vic.gov.au.
videos and comments themselves, which staff can view. Figure 4.5 is a screenshot of the website's opening page.

The ParkView and TRIM systems as well as the SharePoint software behind PVWeb appeared central to Parks Victoria’s long-term information system structure and were of most interest to the research project. ParkView because it uses geographic attributes to access and present data, SharePoint because of its participatory nature, and TRIM for its basic connotation of managing information. They are hence discussed in more detail in the ensuing sections. FireWeb is particularly relevant to the case study topic, fire management, and is discussed in more detail in Chapter 5.

4.4.4.1 ParkView

ParkView is a corporate Web enabled GIS (Votar Partners Pty Ltd 2008), launched in 2005. The system draws on Parks Victoria’s GIS data to provide information using
maps, and searches are performed using geographic attributes. Users can choose Parks Victoria regions or districts to be included on the map base, whilst geographic attributes applied for searches include management area, park name, work centre, coordinates, place name and Bureau of Meteorology (weather) districts. The system is being developed in a modular manner and different modules have been added to the system throughout the research project. As at February 2012, there are eight modules including Asset Management, Indigenous Cultural Values Management, Marine NVM, and the latest instalment, the Melbourne Bushfire Protection Program, added in early 2011. AIS and EIS data are only accessible to most staff via ParkView.

ParkView comprises a variety of user tools including zooming, panning and selecting as well as more advanced functionality. These include creating buffers, measuring distance and area, adding annotation and the function to upload field data collected with mobile GPS devices. Figure 4.6 is a screenshot of the access page to ParkView, whereas Figure 4.7 shows a screenshot of the system after having completed a general enquiry by park name for WPNP.

Figure 4.6 - Opening page of Parks Victoria’s ParkView system.
(Source and copyright: Parks Victoria 2012. Accessed 08 February 2012. Used with permission)
The software behind ParkView is *IntraMaps*, based on *MapInfo* technology. *MapInfo* is a commercial GIS software package that provides tools for spatial analysis and mapping, and is the GIS software in use at Parks Victoria\(^6\). ParkView fulfils the organisation’s strategic plan for business information systems accessible via browsers. Its ultimate aim is to be the corporate map and Web based information system for the whole of Parks Victoria (Votar Partners Pty Ltd 2008).

4.4.4.2 TRIM

The Total Records and Information Management or TRIM system is an application that incorporates the management of both paper and electronic documents (Business Information Systems 2008). All Parks Victoria documents that require keeping as official records, including for legislative reasons, are recorded in TRIM. Although the system has been in place since 1998, its use was limited to only a few staff members. As

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\(^6\) In line with other Victorian Government departments including DSE, Parks Victoria will switch from *MapInfo* to *ArcGIS* in 2012 (Parks Victoria 2012a).
part of a strategy for the management of information, use of TRIM is to be expanded to include the majority, if not all staff members.

The aim of TRIM is to provide a system that gives access to information at Parks Victoria in an effective manner, but also to manage information more efficiently from its creation stage to the point where it has no purpose anymore (Business Information Systems 2008). It forms part of the strategic goal that aims to “provide a single document store for electronic documents and support it with an appropriate search engine to ensure information can be found” (Parks Victoria 2009i, p. 3). TRIM is to be integrated with SharePoint and Microsoft’s Outlook email application, in use at Parks Victoria, which means that relevant documents originating from or existing within these two systems should be easily transferable to TRIM for their management and record keeping (Parks Victoria 2009i). TRIM also has the advantage that it can be integrated with spatial systems, which is an advantage for a land manager like Parks Victoria when creating a spatially based information system (such as ParkView) (J Wotton 2012, pers. comm. 11 June).

By applying TRIM more effectively, Parks Victoria is able to comply with regulations in relation to the management of information in the public sector, as outlined for example in the Victorian Electronic Records Strategy (Parks Victoria 2009i). Parks Victoria as a government organisation also has the legislative requirement to make certain information available, on request, under the Victorian Freedom of Information Act 1982.

4.4.4.3 SharePoint

SharePoint, or known in full as Microsoft Office SharePoint Server 2007, is a software package designed by Microsoft that aims to assist in more effective business operations. It includes tools for information sharing and collaboration between people across different areas and within teams. Business processes can be enhanced through workflow creations, and electronic forms and documents that people can collaboratively create, write and edit (Microsoft Corporation 2009b). SharePoint is essentially proprietary software that incorporates Web 2.0 notions of participation and collaboration.

SharePoint is compatible with the full Microsoft Office suite and other standard and non-standard applications, important for the purpose of interoperability. From Parks
Victoria’s perspective, *SharePoint* would enable staff participation and collaboration, and address the demands the arrival of Web 2.0 has raised. Through the aforementioned PVWeb system, staff can create specific project and team sites as appropriate, write blogs, collectively create wikis and overall manage projects and tasks using a range of tools available such as calendars and project time lines (Bezemer 2009).

From the research project point of view, the software’s Enterprise Content Management feature is of interest, as per the feature’s capability description below:

…organizations have created a huge volume of unstructured content that includes documents, e-mail messages, videos, instant messages, Web pages, and more. This content often exists in a state of unmanaged chaos that prevents an organization from properly using these valuable assets for better knowledge sharing, improved customer communications, and increased process efficiency. Enterprise Content Management… can help companies overcome these challenges (Microsoft Corporation 2009a, para. 1).

Therefore, if the proposed GKT would turn out not to be effective or useful, Parks Victoria could consider employing a technical consultant to advise on the possibilities of applying *Sharepoint’s* capabilities to solve the organisation’s basic data utility issues instead.

4.4.5 **Collaboration and community participation**

A range of factors impact on Parks Victoria’s activities and assets such as fire, water, climate change and urban growth (Parks Victoria 2007). Because these form part of the broader landscape, they are managed in collaboration with other agencies such as DSE, Catchment Management Authorities, local governments or community groups. Parks Victoria in effect states that it aims to deliver its goals in partnership with other government agencies, as well as Traditional Owners and the community (Parks Victoria 2011b).

One of Parks Victoria’s guiding principles is to “…plan and manage public land on behalf of and in partnership with the community” (Parks Victoria 2011b, p. 6). As aforementioned, management plans for individual parks are presented to the community for comment and feedback. It also strives to seek community participation in other
aspects of the parks usage and protection. The focus of the organisation’s activities are the people of Victoria and the notion that parks are positive for the well-being of people, encapsulated in its Healthy Parks Healthy People program (Parks Victoria 2011b, 2011d). A Community Participation Framework outlines Parks Victoria’s intent to actively encourage community involvement (Parks Victoria 2008b). The latest Corporate Plan (2011-14) iterates that the organisation “will continue to work in partnership with key stakeholder groups, volunteers, local communities and visitors to plan and deliver park services” (Parks Victoria 2011b, p. 7).

It is somewhat interesting to note that the previous two Corporate Plans - for 2009/10 to 2011/12 and 2010/11 to 2012/13 – both contain various references to increased knowledge sharing. For instance, the plan to “share knowledge with other park agencies and stakeholders around the world” (Parks Victoria 2009e, p. 10) was part of the long-term goal ‘to manage parks in a climate change era’. Furthermore, to achieve the seventh long-term goal ‘to operate effectively, efficiently, and sustainably’, the aim was to share expertise and skills in relation to fire and emergency management with other agencies worldwide; foster relationships and other partnerships with a variety of other organisations for knowledge sharing; and propose investment for the Asia-Pacific region to build relationships and share knowledge (Parks Victoria 2009e). The latest 2011-14 Corporate Plan however, no longer specifically mention such ‘knowledge sharing’. This is arguably in line with a shift in focus from knowledge management to information management by Parks Victoria (J Wotton 2012, pers. comm. 02 February), as well as the proposed change in management strategy that also omits the ‘knowledge’ issue (refer section 4.4.3).

Some of the strategic actions listed appeared directly aligned with the research project – participation and sharing knowledge. Additionally, to apply “innovative technology to capture and communicate heritage values to the community” (Parks Victoria 2009e, p. 17) was of interest, although why this would not apply to all values instead of just heritage values is not clear. Parks Victoria therefore seems to share, to some extent, key Web 2.0 notions of participation and collaboration. Of course, the organisation acts on behalf of the Victorian Government and as such is arguably ‘working’ for the people; they are the custodians of public land and it would seem prudent to involve the community as they are in effect dealing with community property. Therefore, if the participation and collaboration extended beyond the Victorian public, and aimed to
involve its staff and external organisations, Parks Victoria could truly be an Enterprise 2.0 organisation. As mentioned in Chapter 3.5.3, the organisation already exchanges knowledge with Parks Canada, although its involvement in the KMRt group ceased in November 2011 (J Whelan 2012, pers. comm. 14 February).

Collaboration and knowledge sharing within the organisation is happening at some level at least. For example, knowledge gained and lessons learnt from the 2005 bushfires in the Grampians, in western Victoria, were considered in the decision-making process following the bushfires in February 2009 at WPNP. The Knowledge Nuggets and The Gathering of Wisdom projects aim to assist the dissemination of internal knowledge, whilst the introduction of SharePoint into the organisation could further advance this.

4.5 Collecting and disseminating park data

Considering the research objective to provide data access and the consideration of UCI and emergent technologies, the research project investigated how park related data are currently being collected, or captured, and how are they being provided to people interested in parks. The final section of this chapter firstly discusses methods for collecting data in the park management realm, and finishes with examples of how Parks Victoria and others are disseminating information to park users. According to Li et al. (2007), professionals in natural resource management – encapsulating park management – have traditionally been adopters of new technologies, although they do not necessarily develop their own. The first three examples described are current methods for data capture applied by Parks Victoria. The first two utilise emergent technologies, whereas the latter is a traditional method applied that has not changed to date. The next section describes how Parks Victoria disseminates information to park visitors including in parks and beforehand via its website.

4.5.1 wePlan Alpine

Parks Victoria prepares park management plans for individual parks that require community feedback. Traditionally, information sessions are organised to obtain feedback when such plans are developed. In recent years, draft management plans have also become available on line for people to comment on either by email or letter. The management team of Parks Victoria’s Greater Alpine region adopted a new approach

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61 A fire ignited by lightning on 08 February 2009 burnt over 50% of the park over a five week period (Parks Victoria 2010f).
for the drafting of its management plan, and in particular for engaging the community by using participatory Web tools in its wePlan Alpine project (Parks Victoria 2009g).

The wePlan Alpine project commenced in 2009. It was a Web based application that employed a blog, wikis and an interactive mapping tool. The blog was the main form of communication between Parks Victoria and the community with blog posts published regularly by staff for the community to read and comment on. Registration was required; at final count, the site attracted 768 registered users with both personal and professional interests. Figure 4.8 is a screenshot of the website’s original opening page.

The blog was active throughout the whole planning process whilst the interactive mapping tool was only available during the first stage. The mapping tool aimed to capture people’s personal experience in the parks. Participants could select a park area they had visited, and provide feedback by adding markers and ‘free text’ boxes. The markers represented personal activities and experiences such as camping and wildlife

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viewing, but also environmental impacts like rubbish around a campsite, and dead or sick animals or vegetation. The technology used for the mapping tool was a Public Participatory Geographic Information System (PPGIS) (Parks Victoria 2009h). PPGIS describes just that, a geographic information system that the public can access and utilise, often via a Web based application, to get involved in issues that affect them and aid the decision-making process (Sieber 2006) (as opposed to proprietary GIS software systems that only licenced users can utilise, on often designated computers that have the software installed).

Figure 4.9 is a screenshot of the overview map present after entering the interactive mapping tool, whilst Figure 4.10 displays a selected park area with markers added.

Figure 4.9 - Overview map in wePlan Alpine mapping tool.
The ability to provide feedback using the interactive mapping tool finished in June 2009, after which the project progressed to the actual writing of the draft management plan using two wikis. Besides the Planning wiki, a Knowledge wiki provided background information such as discussion papers, factsheets and maps. Registered community members could edit and contribute to either wiki, discuss their content, and add new documents or maps.

Other Web 2.0 tools employed by the project team were the use of tags and a tag cloud to display them, use of Twitter and links to popular bookmarking sites for the information to be disseminated faster to a wider audience, and the ability by people to upload images onto the site. To cater to all community members, traditional information sessions were also held to both inform and obtain feedback.
The importance of the ability by the community to provide input into the management planning process is perhaps explained through the example of the Australian Trail Horse Riders Association (ATHRA). The Association dedicated a page on their website to the wePlan Alpine project and encouraged its members to participate because “it will determine where you can ride in Victoria’s National Parks for the next 10 years!” (ATHRA 2009, para. 4).

The participatory part of the wePlan Alpine management plan finished with the last blog entry posted on 25 May 2011. Before completion of the original wePlan Alpine project, it was renamed wePlan Parks Victoria with the draft management plan for Point Nepean added to the site in 2010 and completed that same year. Parks Victoria regarded the wePlan Alpine project as innovative (Parks Victoria 2009j). Judging by the number of draft management plans underway and listed on Parks Victoria’s website that seek community participation in the traditional manner however, the wePlan approach appears not to have been embraced as the way forward by the organisation or park managers yet.

4.5.2 Mobile GPS devices

Many Parks Victoria field staff use mobile GPS devices on a regular basis for both the collection and provision of location data. Georeferenced data are required for tasks undertaken as part of various management programs like weed, asset and fire management. A freeware – that is, not OS but not commercial either – software program called Garfile is predominantly used to upload data from the GPS to ParkView or MapInfo (Parks Victoria 2008c).

An investigation into how to optimise communication and business systems provision in the field, or rather remotely, commenced. The Mobile Strategy project looked at the needs of different people, such as field staff, regional managers and corporate staff members, and how these needs could be met in the best possible way. Around 62% of staff is predominantly in the field and away from an office, thus requiring remote access for communication and system access. Although finding solutions to address the needs of regional managers may be relatively easy, this may not be that straightforward for the field staff. This is for a variety of reasons, such as this group’s characteristics of being

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an ageing group and being more averse to new technology, but also due to mobile access constraints. Telstra’s latest Next G mobile network in Victoria has poor if any coverage in quite a few national parks (see Figure 4.11). So even if field staff were happy to use mobile phones or access their laptops remotely, they may be restricted by lack of access to the network instead (C Ramos 2009, pers. comm. 26 November).


New data now being collected within parks mostly have coordinates attached (J Whelan 2011, pers. comm. 23 February) using GPS devices. Standard GPS devices in use include Garmin devices (Parks Victoria 2010a), whilst Blackberries are Parks Victoria endorsed smartphones (although a trial was conducted into the use of iPhones) (Parks Victoria 2010c). A new range of GPS and mobile GIS devices is being distributed to park staff for use for new field data collection, including Juno PDAs and pro-XTs (for sub-metre accuracy). The data collected with these devices, whether a point, line or area, are geographically defined with geographic coordinates with a range of other attributes also attached. As aforementioned, the ParkView system includes a tool to
upload GPS data directly into ParkView so the GPS data can be viewed against existing data already in ParkView and saved accordingly.

Finally, GPS technology is also used by Parks Victoria rangers in maritime areas. For instance, mobile GPS devices are being applied for the mapping of underwater boundaries and territory of marine parks and reserves, whilst GPS and Internet on patrol boats can identify boats moored illegally (Parks Victoria 2010d).

**4.5.3 Annual Asset Validation**

Part of Parks Victoria’s legislative requirements is to conduct a validation of its assets. This process has a number of purposes including updating and correcting asset information, particularly high risk or high values ones, and identifying those assets that have either deteriorated and require maintenance, or have improved due to having undergone maintenance (Parks Victoria 2009b). Any changes observed were until recently entered into the AIS, and since 2009 in ParkView's Asset Management module.

The asset validation is undertaken by field staff in the parks. For the 2009 asset validation, the process comprised the completion of spreadsheets using laptops in the field for the electronic validation of assets. Locational details were recorded with handheld GPS devices. The spreadsheets together with any photos and other relevant documents were saved in specific folders on a corporate drive. Staff from the Asset Information team manually updated the information in AIS, after which it could be transferred to ParkView for access by users (Parks Victoria 2009b). The 2010 asset validation focussed on assets that were previously classed as being in poor or very poor condition, as well as any assets not validated in 2009 using a similar process (Parks Victoria 2010a). The asset validation has since become an ongoing process (R Swaminathan 2012, pers. comm. 16 February).

The spreadsheets for the 2009 validation comprised 31 columns (22 of which were editable) for possible asset attributes. Examples of information in the column headings included old and new asset ids; an asset description; GDA 94 map zone, easting and northing details; the location capture method; and the overall condition rating. Figure 4.12 shows a small portion of the 2009 spreadsheet for WPNP. It listed over 750 assets ranging from campgrounds, cottages, stores, tracks and roads, to pipelines and specific items like car park bollards and a cinema screen.
A process is in place to updates assets outside the recurring validation, and requires relevant details to be emailed to the Asset Information team for update in AIS and ParkView (Parks Victoria n.d.-a). Staff can also add, edit and delete assets in these systems (Parks Victoria 2011c).

A final method to collect park related data is using volunteers; people who come to the park to undertake data collection activities for a particular purpose. The Victorian National Parks Association for instance, in collaboration with others including Parks Victoria and Friends groups, coordinated volunteers for disease monitoring projects in WPNP and the Brisbane Ranges National Park (Parks Victoria 2009d), located about 80 km west of Melbourne. The Conservation Volunteers organisation organises similar projects, although volunteers pay for the privilege to contribute to the conservation of the park (Conservation Volunteers 2010).

### 4.5.4 Provision of data to park users by Parks Victoria

Parks Victoria provides data to park users in more or less traditional methods. Information can be obtained before a visit to a park from the organisation’s website or by contacting the Information Centre by email or phone.\(^6\) At the destination, visitor centres in parks provide visitors with a range of information; maps and information

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\(^6\) According to the 2010-11 Annual Report, digital enquiries via the website and by email have increased over the last year whereas phone calls to the Information Centre have reduced in number (Parks Victoria 2011g).
sheets and brochures are available to take away (some for free, others for a fee), and staff is on hand to answer questions. Visitor centres may have a display for educational purposes, and a notice board generally gives information such as weather conditions and the like. Information boards can also be found around the park, displaying a range of information. Some parks offer guided tours or organise other special events to inform visitors about specific topics.

Parks Victoria’s website provides a range of information useful to park visitors. The site was recently updated to a more Web 2.0 oriented site (the first phase became public in August 2011), and includes an interactive mapping tool. Information found on the site includes the latest conditions and information about special topics such as endangered species, pests and ecosystems. People can plan their visit using the interactive mapping tool or journey planner, or download most of the information available in hardcopy from a park visitor centre as a digital file. Some prepared maps in PDF format are available for download onto Apple’s range of mobile devices.

Alongside the new participatory website, Parks Victoria has also joined four key Web 2.0 applications - Facebook, Twitter, Flickr and YouTube. Park visitors can thus obtain information and communicate with staff through these applications before, during or after a visit to a park. Figure 4.13 is a screenshot of some of the tweets written by Parks Victoria.

4.5.5 Technologies applied by others

This last section describes three examples of other projects in the park management realm, outside of Victoria, that employ technologies that have emerged to capture or provide park related data.

4.5.5.1 WebPark

WebPark commenced as a research project in 2001. Its aim was to “create a platform to deliver Location Based Services in protected and recreation areas” (Edwardes, Burghardt and Weibel 2003, p. 1). Visitors to such areas would be presented with a range of information appropriate to their location and accessible through mobile devices. The kind of data provided by the tool was flora and fauna information and

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other points of interest. A mapping and navigation tool allowed for spatial searches and for the georeferenced information to be presented on a map base (Edwardes and Grossman 2012).

After completion of the project in 2004, WebPark became a commercial product and is currently presented as “a mobile information system that provides visitors of natural areas and parks with information about their surroundings using smart phones and GPS” (Geodan 2012, para. 1). The project used two study sites to test the application: the Swiss National Park and the Dutch island of Texel. When now visiting the Swiss National Park, the WebPark application is available as a multimedia guide to pick up the park, or is downloadable as a mobile app onto one’s own device.\footnote{Refer www.nationalpark.ch/go/en/visit/hiking/webparksnp-multimedia-guide/ for more details.}
4.5.5.2 A Bird in the Hand app

The Tasmanian Parks and Wildlife Service, Parks Victoria’s equivalent in the State of Tasmania, Australia, has been involved in the development of a mobile application. Users of the *A Bird in the Hand* app, developed in partnership with the company Geometry, can obtain a variety of information about birds they encounter including sounds, images and textual details (Geometry 2008). The Parks and Wildlife Service (2009) recognises “that information is an important resource in the conservation of our native species and using unique and innovative method of delivering detailed information is only the start”. The aim is to develop similar applications for Tasmania’s native wildlife and national parks in general. Although developed in partnership with a park management organisation, the bird app can be used by people anywhere of course.\(^{67}\)

Both *WebPark* and the *A Bird in the Hand* app provide information to park users only. The tools are not participatory or collaborative in nature whereas the last example is collaborative; it focuses on sharing of knowledge and draws on the collective intelligence notion described in Chapter 2.3.

4.5.5.3 Fire History 2003 Okanagan Mountain Park Fire

As part of the Fire Mapping project, researchers from the Kelowna Fire Museum and Education Centre and University of British Columbia Okanagan, Canada have created an interactive mapping tool (University of British Columbia n.d.). The tool focuses on the 2003 fires at Mountain Park, managed by BC Parks, in charge of managing parks in Canada’s province of British Columbia on behalf of the province’s Ministry of Environment (BCParks n.d.). Using *Google Maps* as a base combined with other software, the two maps provided visualise the development of the fire over the 21 days it took place. The aim is not to just inform people of the events, but for people to share their experiences with fires with others as well, and provide a place for those experiences to be recorded. The tool can collect individual bits of knowledge so that a “patchwork of group knowledge” may be created (University of British Columbia n.d., para. 2). Figure 4.14 is a screenshot of a map on the project website.\(^{68}\)

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\(^{68}\) Refer [firehistory.ok.ubc.ca](http://firehistory.ok.ubc.ca) for more details.
4.6 Chapter summary

The purpose of this chapter was to provide insight into park management in general and aspects of Parks Victoria as an organisation. The information described was considered to be potentially useful and relevant for components of the GKT, the case study or demonstration prototype. Following the previous two chapters on Web 2.0 and knowledge and knowledge systems, this chapter has concluded the background review to the research project.

Parks Victoria being a park management organisation, the chapter discussed aspects of park management, parks and provision and dissemination of park related data. This included a broad overview of park management and its history, and the management of parks in Australia and Victoria. Shifting focus to Parks Victoria, topics considered relevant included the organisation’s structure and goals, its strategic framework for effective park management, as well as information systems in use by staff. A section on collaboration and community participation described the organisation’s commitment to
involving the community in its planning and management of parks, although this is arguably a legislative necessity, Parks Victoria being the custodians of public land.

The final part described a number of different methods for collecting and providing park related data. The first four examples talked about Parks Victoria, whilst the last three looked at examples in the park management realm elsewhere that have applied emergent technologies. Some of these drew on emergent concepts of participation and collaboration, and the collective intelligence that exists although others merely provide information. Most did take on board emergent technologies however. Parks Victoria has, and is, considering new technologies in some instances, but in the case of its annual asset validation process, opportunities that such new technologies provide to improve the process are not yet applied.

The examples provided in the final section, as well as those described in the previous two chapters (refer chapters 2.3.6 and 3.6.4), arguably showed that taking up new technologies and applying them to suit a purpose can be beneficial. This ultimately was what this research project also aimed to do: apply emergent Web technologies to suit Parks Victoria’s aim of finding a new method to make its data more accessible – and to access, capture and disseminate both Parks Victoria data and alternative data made available on the Web and through participatory tools.

This chapter has concluded the exploratory phase of the research project that focussed on information gathering. The lessons learnt and knowledge gained, broadly described in chapters 2, 3 and 4 can be applied to or considered for the implementation phase that deals with the primary undertaking of developing a theoretical methodology for a GKT.

The next chapter – Case Study: Wilsons Prom, Fire Management and Planned Burn Preparations – moves to the implementation phase and describes the case study component of the research project. There are two main parts to this phase: the development of the conceptual GKT and the subsequent demonstration prototype, both of which include preliminary activities. After introducing aspects of the case study including its focus areas of WPNP and fire management, the chapter firstly discusses fire management and decision-making. This includes information needs for fire management. The next section discusses non-traditional data sources available on the
Web and applicable to the case study, before moving to a park visitor survey conducted to gain insight into people’s views on Web 2.0.

The first main part commences with a description of the conceptual GKT. Next, two issues associated with the functioning of such a tool and theoretical solutions developed are outlined in more detail - data quality and variation in georeferencing of data. The chapter concludes with the second main part – the development of the demonstration prototype – and describes the overall design process from the proposed use scenario and data needs to the prototype's assessment by stakeholders.
Chapter 5. Case Study: Wilsons Prom, Fire Management and Planned Ecological Burns
5.1 Chapter overview

After chapters on what Web 2.0 entails; an overview of knowledge and knowledge systems from *Renvois, Memex*, hypertext and the Web, to Al Gore’s Digital Earth, to current knowledge systems that can apply collaboration and user contributed geospatial data; and finally a look into park management and Parks Victoria, this chapter describes the case study component of the research project.

To iterate, the essence of the research was to develop a theoretical methodology for a knowledge system for accessing georeferenced data. The methodology would consider aspects of emergent Web developments that include the participatory and collaborative elements of Web 2.0 and the GeoWeb, in effect creating a collaborative geo-knowledge system as discussed in Chapter 3. The primary function of this system – defined as a geo-knowledge tool (GKT) by the research project – would be to provide access to different, georeferenced data. Parks Victoria’s existing data archive would form the base data to be supplemented by alternative data sources available via the Web or obtained through collaborative and participatory tools. The case study broadly involves tasks associated with and the actual development of a conceptual GKT and demonstration prototype.

This chapter firstly introduces the case study. It starts with an overview of the study area – Wilsons Promontory National Park (WPNP) – and topic – fire management and ecological planned burns for detailed requirements –, and finishes with an outline of the case study’s main components. The next section discusses aspects of fire management and decision-making at Parks Victoria with a view to ecological fire management and planned burns. Key information requirements are outlined from a legislative perspective, governmental and corporate policies and guidelines, information specific to a local park, and people to be consulted. The investigation into fire management data requirements concludes with a summary of available data at Parks Victoria, before moving onto alternative data sources. Existing data available on the Web are firstly discussed, focussing on examples of digital data repositories that are potentially relevant. The ensuing section looks at park visitors as an alternative data source, and discusses the results and analysis of a park visitor survey conducted at WPNP to gain insight into visitors' perceived willingness to participate and contribute information.
The conceptual GKT is described next, and the various components of the tool are explained. Two issues encountered that form part of the conceptual model are discussed in more detail and theoretical solutions are proposed. These are the issue of data quality and the issue of variation in georeferencing. The final part of the case study chapter discusses the process for developing the demonstration prototype. This includes the development of a use scenario and subsequent data needs, and designing the interface. The final section describes the review process of the demonstration prototype by stakeholders.

5.2 An introduction to the case study

The case study focused on the overall development of a methodology for the GKT, consisting of two main parts: the development of a conceptual GKT and the building of the demonstration prototype. To focus the activities at hand, one of Parks Victoria's parks was chosen as the study area, whilst a portion of its data was used for the conceptual model and the demonstration prototype.

5.2.1 Study area: Wilsons Promontory National Park

Often colloquially referred to as The Prom or Wilsons Prom, WPNP is one of the oldest national parks in Victoria and Australia. It was declared a national park in 1898. It is located about 200 km southeast of Melbourne (see Figure 5.1), and includes South Point, the most southern point of mainland Australia. Its borders comprise 130 km of scenic coastline that is surrounded by a number of marine and coastal parks and reserves (Parks Victoria 2009k). The park comprises three reference areas, a wilderness zone and a natural and remote area including 11 islands (Parks Victoria 2003). With a land area of close to 50,500 hectares (Parks Victoria 2009k), it is the tenth largest national park in Victoria (Parks Victoria 2003).

WPNP plays an important role in the protection of Victoria’s biodiversity. It houses a vast amount of flora and fauna species that include rare and threatened species, whilst vegetation communities include warm and cool temperate rainforests, woodlands and heathlands. The park is predominantly made up of granite creating ridges, with the entire park recognised as having “national geological and geomorphological significance” (Parks Victoria 2002, p. 2). Other landscape features include beaches, swamps, dunes, cliffs, rivers, creeks and tidal estuaries (Parks Victoria 2003).
The area that is now WPNP has a long history of Aboriginal occupation dating back at least 6500 years. European settlers first sighted the park in 1798, and its natural resources were soon exploited with sealing being an early activity. Other post-colonial commercial undertakings include whaling, timber milling, gold and tin mining, cattle grazing and lime quarrying - the latter two continued until 1992 and 1993 respectively (Parks Victoria 2003). Some of these have left an ecological impact on the park through a changed landscape, a change in natural vegetation and a resulting diminished biodiversity.

WPNP has attracted visitors from its early days – limited records show that 66 people camped in the park between 1912 and 1916 – with access difficult in those early days (Catrice ca. 1994). A campground and other facilities started to materialise soon after the Second World War, centred on Tidal River and turning the park into the primary destination for visitors to Victorian national parks. WPNP is currently regarded as one of the most important tourist destinations in Victoria attracting both day and overnight visitors. In a 2009 poll by the Royal Automobile Club of Victoria, the park was voted the number four 'must do' tourism experience for Victoria. Visitor activities include camping, bushwalking, hiking, fishing and other water sports, with both natural and

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cultural attractions abound. WPNP contributes significantly to both the regional and state economies (Parks Victoria 2002).

5.2.2 Topic: fire management and ecological planned burns

Chapter 4 - Park Management, Parks and Park Data - showed that Parks Victoria has categorised its core business into four main management areas – natural values, cultural values, visitor services, and fire and emergency management –, each comprising a number of subcategories. For the purpose of the case study, fire management was chosen as the broad focus topic, whilst ecological planned burning was selected for more detailed requirements. These topics were chosen in part because of the relevance of fire management during the first year of the research – and remaining so – when considering the bushfires that have occurred in Victoria in recent years70, and their ongoing impact on people and the environment. The Chairman, Rob Gerrand, wrote in the organisation’s 2008-2009 Annual Report that…

> Fire and emergency management has become an increasingly important role for Parks Victoria. With more than 800 staff trained in fire roles across the state, it is a core function for the organisation. With a changing climate and more people living along the coast and in forested areas, the organisation will continue to develop its knowledge, capacity and preparedness to respond to and plan for the risks associated with fire... (Parks Victoria 2009c, p. 4)

The Chairman’s message in the 2009-2010 Annual Report reconfirmed the growing importance of fire management and the organisation’s major role with regards to the recommendations made by the 2009 Victorian Bushfires Royal Commission (Parks Victoria 2010e). However, the focus for the case study was not on the suppression of these wildfires, but on the use of controlled or planned burning in parks. The practice of planned burning firstly aims to reduce the chance of bushfires occurring or to reduce their impact by reducing available fuel levels. Secondly, ecological fire management practices involving planned burning exist to protect natural values and biodiversity, because “Fire is required in many ecosystems to maintain a diversity of flora and fauna species” (Parks Victoria 2007, p. 96).

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70 In the first decade of the 21st century, major bushfires occurred in Victoria alone in 2002, 2003, 2005-06 and 2006-07, culminating with Black Saturday on 07 February 2009, the worst bushfires in Australian history that cost 173 lives and affected vast parts of the State including 70 national parks and reserves (Department of Sustainability and Environment 2011a).
WPNP has a fire history dating back to Aboriginal times, and the changed landscape as a result of European settlement has made some of the later fires very severe. The 2009 bushfire, ignited by lightning, burnt over 50% of the park over a five week period (Parks Victoria 2010f). There were seven recommendations made by the Victorian Bushfires Royal Commission in response to the 2009 Victorian fires in the category Land and Fuel Management, including a commitment to a long term controlled burning program (Victorian Bushfires Royal Commission 2009). From an ecological management perspective, WPNP has over 1200 flora species (Stoner 2007) that require varying fire regimes in order to protect species and maintain biodiversity. Fire management and planned burning are a somewhat topical issue on the current agenda of park managers in Victoria (and Australia generally), while the protection, or perhaps, halting the loss of biodiversity is also becoming a prominent issue and simultaneously adheres to legislative requirements. It therefore seemed prudent to have chosen this topic for the case study so that an enhanced methodology for relevant data access could potentially be developed.

5.2.3 Users: staff engaged in fire management activities

It was envisaged that a fully developed GKT could potentially be used by all Parks Victoria staff as well as other stakeholders such as staff of other agencies, park visitors or the general public – for example, through designated terminals at a park’s visitor centre or by making the GKT available externally via the Web. For the conceptual GKT and the demonstration prototype, the case study focused on staff and stakeholders engaged in fire management or ecological planned burn activities, particularly at WPNP but also elsewhere.

5.2.4 Main phases of the case study

The case study comprised two main phases: the development of a conceptual GKT and the building of a demonstration prototype, each of which contained various tasks. The first phase started with investigative activities that, combined with findings described in

\[71\] 2010 was the United Nations International Year of Biodiversity. The associated biodiversity summit held in Japan in October 2010 resulted in a global, strategic framework for the protection of biodiversity – see www.cbd.int/cop10/ for more details. Australia has developed Australia’s Biodiversity Conservation Strategy 2010-2030 to assist it reaching biodiversity protection targets (see www.environment.gov.au/biodiversity/strategy/index.html).
chapters 2, 3 and 4, led to the development of a conceptual GKT. These activities included:

1. An investigation into data requirements and decision processes for fire management and ecological planned burns;
2. An investigation into potentially relevant non-traditional data sources with a focus on existing data archives on the Web;
3. A visitor survey at WPNP, seeking feedback from park visitors on their views and use of Web 2.0 tools and their perceived willingness to participate and contribute information; and
4. Considering issues encountered and proposing theoretical solutions for two: the quality and usefulness of alternative data and the variation in georeferencing of data that exists.

The second phase of the case study was to build a demonstration prototype to assess the theories being applied. The demonstration prototype was based on aspects of the conceptual GKT, and designed using limited data and functionality. After completion, it was reviewed by stakeholders. Full details of the two phases and associated activities are described in the remainder of this chapter. An analysis of the feedback received as part of the demonstration prototype review is described in the ensuing Chapter 6 – Analysis and Discussion.

It should be noted that the term ‘data’ is used throughout this case study chapter. Although it was defined in Chapter 3 within the Data-Information-Knowledge-Wisdom model, the term ‘data’ in the context of this chapter in particular, is broader than this basic meaning, and represents all types of files, documents and tools in many formats that Parks Victoria possesses. Although technically some of these may not be ‘data’ in a literal sense, they form the basis for the proposed GKT and are the ‘data’ originating from Parks Victoria’s data archive.

5.3 Fire management and decision-making

In order for a GKT to provide useful information for fire management activities, the general data requirements and decision processes needed to be understood. An investigation was therefore conducted that looked into fire management and planned burn requirements from different perspectives, and from a broad organisational perspective down to a local park level.
The following three questions summarised the investigation:
1. What is required considering legislation, governmental and Parks Victoria policy, and park management;
2. What data are currently held and utilised, and how are they accessed; and
3. Who needs to be consulted?

These, together with a general overview of fire management, are addressed in this section

5.3.1 Fire management at Parks Victoria

Fire management at Parks Victoria requires “managing the threat and occurrence of wildfires and the use of prescribed burning to achieve specific fire and other management objectives” (Department of Sustainability and Environment 2006, p. 3). It involves the management of two types of fires: unplanned and planned, or bad versus good ones (D Nugent & A Graystone 2010, pers. comm. 15 March). Fire management activities therefore have two key roles: fire suppression of unplanned fires and conducting planned fire in line with management objectives. Fire suppression of unplanned fires is essentially the protection of people, assets and parks itself, and related fire management activities include fire prevention, preparedness, response and recovery. The main objectives for the conducting of planned burns are ecological management, forest regeneration, and fuel reduction (Parks Victoria and Department of Sustainability and Environment 2009). The latter, fuel reduction burns, are linked to the role of fire suppression, by mitigating the risks of unplanned fires happening. This in effect is another form of protecting people and assets, and fire is considered “…the strongest tool available to reduce the threat of severe bushfires…” (Department of Sustainability and Environment 2008c, p. 9).

Although Parks Victoria manages parks on behalf of the Victorian Government, as outlined in the Parks Victoria Act 1998 (see previous section 4.3.1), they work closely with the Department of Sustainability and Environment (DSE). This is because DSE is the government department responsible for fire management as outlined in the Forests Act 1958 (s. 62(2)), which requires them to “carry out proper and sufficient work for the prevention and suppression of fire in every state forest and national park and on all protected public land”. It stipulates that they must do the latter in agreement with those who are in charge of managing those parks, thus Parks Victoria. DSE is also assigned
the legislative duty to manage parks based on environmental values in the *National Parks Act* 1975 (see later section 5.3.2.1 on legislation). Hence, DSE is the lead agency involved in fire management, developing policies, but simultaneously having a land management role including practices that require fire regimes (D Nugent & A Graystone 2010, pers. comm. 15 March). In practice, DSE and Parks Victoria are regarded as equal partner agencies in fire management (J Stoner 2010, pers. comm. 30 June).

5.3.1.1 Cascading framework

Fire management at Parks Victoria is a cascading framework (D Nugent 2010, pers. comm. 15 March; Department of Sustainability and Environment 2006) that abides by the legislative requirements outlined in various Acts, to provide policies, strategies and plans at a broad statewide level down to park specific plans and actions. This framework for fire management planning and organisation comprises the following levels:

- Legislation
- Statewide policy, strategies and guidelines
- Regional instructions, strategies and guidelines
- Fire districts
- Local / park level

Putting this cascading structure in the context of WPNP – apart from legislation and statewide policies –, the park currently forms part of the Central region (area), and falls under the South Gippsland fire district\(^72\) (Department of Sustainability and Environment 2011b). Figure 5.2 is a portion of a DSE map that shows the boundaries for the Central region and its subdivision of fire districts encompassing WPNP.

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\(^{72}\) These regions and divisions are derived by DSE and relate to fire management only, thus confirming DSE’s legislative leadership. The boundaries differ from Parks Victoria’s own managerial organisation where WPNP comes under the East region and Wilsons Promontory District.
The cascading style of fire management planning and organisation reverses in part when it comes to approval (D Nugent & A Graystone 2010, pers. comm. 15 March). Detailed burn plans for example, used to prepare for an individual planned burn in a park, require approval at an area level for the go-ahead. Theoretically, if multiple burn plans for different parks are ready to be executed, an area manager decides which burns can commence and which ones have to wait, based on available resources such as manpower to patrol the fires and specialty incendiary equipment.

5.3.1.2 Planned burn objectives

Planned burning is synonymous with prescribed or controlled burning, fire regimes and land management burning, whilst fuel reduction burns and ecological burns are specific examples of planned burns. When preparing for a planned burn, it is important to focus on the primary objective: ecological or fuel reduction (D Nugent & A Graystone 2010, pers. comm. 15 March). Ecological burns are aimed at protecting and/or enhancing biodiversity, and although all planned burns have an ecological aspect, it is ultimately dependent on the applicable Fuel Management Zone (FMZ) where the focus lies. FMZs are used for the planning and management of fire, and specify the key fire management purpose for each area of land (Department of Sustainability and Environment 2006).
The FMZs are described in the *Code of Practice for Fire Management on Public Land* (2006 revised version) and comprise the following four zones:
- FMZ1 Asset Protection Zone;
- FMZ2 Strategic Wildfire Moderation Zone;
- FMZ3 Ecological Management Zone; and
- FMZ4 Prescribed Burning Exclusion Zone

(Department of Sustainability and Environment 2006).

There is a gradual increase from management for the purpose of fire protection to the management for ecological outcomes in this FMZ framework. Areas classified as FMZ1 having a high focus on asset protection, whereas areas designated as FMZ4 have a primary focus on ecological fire management (see Figure 5.3).

![Figure 5.3 - Variation in fire management focus for various Fire Management Zones (FMZ).](Adapted from Department of Sustainability and Environment 2006, p. 16)

It is recognised that the management objectives of protecting life and assets versus that of protecting biodiversity and other ecological values can be difficult to achieve simultaneously. Although compromises may have to be made, there is a strong emphasis in achieving multiple land management objectives (Department of Sustainability and Environment 2006). All fires already have an ecological impact, including lack of fires, and ecological burns often also enhance the protection of assets. Subsequently, in order to achieve an appropriate balance between the two objectives, it is important to understand what role fire plays from an ecological perspective, what the

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DSE in late 2011 omitted reference to FMZs and refers to 'fire management zones' instead, whilst using acronyms of the four zone descriptions (APZ, SWMZ, EMZ and PBEZ) - see www.dse.vic.gov.au/__data/assets/pdf_file/0004/120298/FINAL-FMZ-Fact-Sheet.pdf.
legal obligations are in regards to human and asset protection, and what resources are available for land and fire management (Fire Ecology Working Group 2004). This information is essential to good decision-making in fire management, and should thus be accessible through the GKT.

### 5.3.2 Fire management data requirements

The core data that enables good decision-making in fire management are the issues just mentioned - understanding the ecological role of fire, legal obligations, and available resources. These essentially lie within investigative framework encapsulated by the three questions previously posed:

1. What is required considering legislation, governmental and Parks Victoria policy, and park management;
2. What data are currently held and utilised, and how are they accessed; and
3. Who needs to be consulted?

The answer to the first question is summarised by Figure 5.4 below:

![Figure 5.4 - Examples of key legislation, policies, guidelines and other documents relevant to fire management relevant to WPNP.](image-url)

Figure 5.4 outlines key legislation that needs to be adhered to, overarching policies, strategies and guidelines provided at a State and organisational level, the descent to a
regional and fire district approach, and finally documents specific to WPNP. The figure’s various elements are next explained in more detail thus answering question 1 above, and continuing with answers to questions 2 and 3.

5.3.2.1 Legislation

There are numerous legislative requirements and responsibilities for park and fire management. These are obligations that Parks Victoria as an organisation as well as individual staff members must comply with when undertaking their duties. Three main duties are the protection of human life and property, the protection of biodiversity, and the general management of public land. Other legislative requirements include the protection of cultural values and safety of personnel (Department of Sustainability and Environment 2006).

The previous section 4.3.1 provided a broad overview of the legislative framework under which Parks Victoria operates. This included the two key pieces of legislation to assist the organisation in achieving its primary duty of park management: the *National Parks Act 1975* (Vic) and the *Crown Land Reserves Act 1978* (Vic). Following is key legislation that applies to park and fire management, with the former primarily regarded from an ecological perspective in this instance.

- **National Parks Act 1975**
  - Stipulates to”… ensure that each national park and State park is controlled and managed in a manner that will… (i) preserve and protect the park in its natural condition… ; (ii) preserve and protect indigenous flora and fauna in the park” (*National Parks Act 1975*, s. 17(2));
  - In line with fire management objectives, the same section further states to “(aa) have regard to all classes of management actions that may be implemented for the purposes of maintaining and improving the ecological function of the park; (b) ensure that appropriate and sufficient measures are taken to protect each national park…from injury by fire” (*National Parks Act 1975*, s. 17(2)).

- **Forrests Act 1958** (Vic)
  - Aimed at the “protection of human life and property through fire prevention and suppression” (Department of Sustainability and Environment 2006, p.4). States to”…carry out proper and sufficient work for the prevention and
suppression of fire in every State forest and national park and on all protected public land...” (*Forests Act* 1958, s. 62).

- **Flora and Fauna Guarantee Act 1988 (Vic)**
  - Focuses on the protection of biodiversity, and enables and promotes “the conservation of Victoria’s native flora and fauna and to provide for a choice of procedures which can be used for the conservation, management or control of flora and fauna and the management of potentially threatening process” (*Flora and Fauna Guarantee Act* 1988, s. 1);
  - A requirement of the Act is for DSE to prepare Action Statements for each threatened flora and fauna species or community listed. These include information about what has been done and will be done to conserve the species, and are updated every three to five years (Department of Sustainability and Environment 2010d).

The protection of biodiversity is also achieved through the federal *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) (Department of Sustainability and Environment 2006), the aforementioned *Forest Act* 1958 and *National Parks Act* 1975, and the *Wildlife Act* 1975 (Department of Sustainability and Environment 2010f).

Other legislation that plays a role is:

- **Parks Victoria Act 1998**
  - Mainly outlines how Parks Victoria as an organisation should operate, but also specifies that “in carrying out its functions, Parks Victoria must not act in a way that is not environmentally sound” (*Parks Victoria Act* 1998, s. 7(2)). It further “may enter into agreements relating to the prevention and suppression of fire [with DSE]” (*Parks Victoria Act* 1998, s. 9).

- **Country Fire Authority Act 1958 (Vic)**
  - Although for private land, Parks Victoria often works with the Country Fire Authority (CFA) as fires undoubtedly cross borders from public to private land (D Nugent & A Graystone 2010, pers. comm. 15 March). Like the *Forest Act* 1958, it is aimed at protecting human life and assets (Department of Sustainability and Environment 2006).

- **Emergency Management Act 1986**
  - States to ensure that the three objectives of prevention, response and recovery “are organised to facilitate planning, preparedness, operational co-
ordination and community participation”, with prevention including “...the mitigation of their [(emergencies including fires)] effects” (Emergency Management Act 1986, s. 4A).

A number of other Acts are applicable, in part depending on where burning takes place and what assets may be affected. For instance, a park's cultural heritage is protected through the Heritage Act 1995 (Vic) and the Archaeological and Aboriginal Relics Preservation Act 1972 (Vic) at a State level, and the Native Title Act 1993 (Cth) and the Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) at a Federal level. Other Acts that cover aspects of park management or public land in general include the Crown Land (Reserves) Act 1978, the Conservation, Forests and Lands Act 1987, the Catchment and Land Protection Act 1994, and the Lands Act 1958 (Department of Sustainability and Environment 2006).

A detailed statutory and policy framework for Victoria’s parks and reserves outlines a host of other international, national and state agreements, policies and legislation. All of these apply to the management of parks, and, directly or indirectly, may affect fire management decisions.

5.3.2.2 Governmental and Parks Victoria policies, strategies and guidelines

Strategies and guidelines are in place to achieve a systematic approach to park and fire management. These simultaneously provide a robust framework built on sound principles, setting minimum standards while fulfilling legislative and land management obligations. A list of key governmental and organisational policies, strategies and guidelines relevant to fire management and WPNP, where applicable, and valid at time of writing is outlined in the following sections.

  - From here on in also referred to as the Code of Practice, it provides a framework for fire management planning and activities on public land in an efficient, effective, integrated and consistent manner, by defining and

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75 The Code of Practice is currently under review with a revised version expected in the middle of 2012 (Department of Sustainability and Environment 2012)
applying principles standards and guidelines for such undertakings (Department of Sustainability and Environment 2006);

- Considered the overarching document (D Nugent & A Graystone 2010, pers. comm. 15 March) that any other fire management plans or guidelines developed for public land in Victoria must adhere to (Department of Sustainability and Environment 2006).

**Fire Ecology Program Strategic Directions 2009 – 2011 (2009)**

- Provides a strategic framework for fire ecology management through a three year program that comprises objectives and strategies covering five areas: landscape planning and management; science and research; monitoring and assessment; information management and knowledge sharing; and stakeholder engagement and communication (Fire Ecology Working Group 2009);

- Is based on “the understanding that, in the absence of knowledge about prior fire history and management, key elements of the life histories of plants and animals relating to fire (their ‘vital attributes’) contain the information that can help determine appropriate fire regimes to maintain them in the landscape” (Fire Ecology Working Group 2009, p. 1).


- Provides a practical and adaptive framework to guide management decisions. It describes the principles and standards associated with ecological burning, as well as the planning procedures required for such burning (Fire Ecology Working Group 2004);

- Describes the key steps for developing a fire ecology assessment at a local level and for particular land management units (Stoner 2007).


- Outlines a step-by-step approach (comprising 17 steps) for developing an ecological burn strategy or fire ecology assessment (see section 5.3.2.3).

Strategies and guidelines at a regional level include:

**Regional Fire Protection Plans (FPP)**

- Ten year plans that provide a regional, strategic approach to fire management in relation to wildfire prevention, preparedness, suppression and recovery (Department of Sustainability and Environment 2010c);
- Aimed at assisting decision-making and fire management activities at a local level, and can be reviewed or amended within the 10 year period as appropriate;
- The Gippsland FPP is currently applicable to WPNP, although the park now falls under the Central fire area.

- **Fire Operation Plans (FOP) for fire districts**
  - Three year plans that are prepared and reviewed annually for each fire district.
  - Detail proposed fire management activities including planned burns for ecological and fuel reduction purposes in the district for the first budget year (Department of Sustainability and Environment 2006);
  - The South Gippsland FOP is applicable to WPNP. Figure 5.5 shows the prescribed burns planned for the park for 2010 – 2013 (as at April 2011).

Figure 5.5 - WPNP portion of South Gippsland Fire Operations Plan and legend.

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76 DSE amended its framework of fire regions and districts in 2008, with WPNP currently falling under the Central fire management area (formerly regions), and the South Gippsland fire district. No new FPP for the Central area has been developed since the amendments.

77 The South Gippsland FOP uses five Fire Fuel Management Zones, which are the predecessors to FMZs. As no new FPP has been written for this fire district since the adoption of the four FMZs, the previous zone system is utilised until such plan is written (Stoner 2007).
A number of other policies and strategies relate to fire management. Victoria’s Biodiversity Strategy, for example, complies with the management obligations outlined in the Flora and Fauna Guarantee Act 1988 (Department of Sustainability and Environment 2010g). After an evaluation of the 1997 Strategy in preparation of a renewal due in 2010, a White Paper was prepared (Department of Sustainability and Environment 2010g). Chapter 6 of this Land and Biodiversity at a Time of Climate Change White Paper mentions one of the policies in relation to fire management: an increase in planned burning “including the use of landscape-scale mosaic burns based on ecological and risk management objectives to complement the existing strategic asset protection burning approach… [that] will consider ecological values and ecosystem services, including the management of fire sensitive vegetation types” (Department of Sustainability and Environment 2009c, p. 79). It is understood that these policies are subsequently incorporated into specific fire management strategies such as regional FPPs.

5.3.2.3 Documents focussing on Wilsons Prom

Apart from the statewide and regional policies, guidelines and strategies listed in the previous sections, some documents are particular to WPNP. Although generally developed at a higher level, such as a fire district or Parks Victoria region, they incorporate local knowledge and specifically focus on WPNP, its management objectives and particular conditions.

The key documents relating to fire management, and ecological fire management in particular, are:

- Fire Ecology Assessment (FEA) WPNP (2007)
  - Developed at a fire district level and based on a landscape level. WPNP has its own FEA because the park is regarded as a landscape by itself (Stoner 2007);
  - Also referred to as an ecological burn strategy, a FEA applies the aforementioned Guidelines and Procedures for Ecological Burning on Public Land in Victoria (2004), and results from the step method
described in the *Ecological Burn Strategy - Practitioner’s Manual* (Fire Ecology Working Group 2003);

- Describes the ecological objectives to be achieved through planned burns for the purpose of maintaining biodiversity. It applies an adaptive experimental management approach that provides for the planning phase, how to achieve the objectives and subsequent monitoring and feedback phase (Fire Ecology Working Group 2003).

- Regarded as a guide, the FEA is used to develop the FOP – an action plan that can be implemented;

- As a result of the February 2009 Cathedral fire that burnt over half of WPNP and had a severe ecological impact on the landscape, the 2007 FEA was updated in late 2009;

- **WPNP Management Plan (2002)**

  - Long-term strategic document that provides the basis and future management directions for the park (Parks Victoria 2002);

  - Lists 10 fire management strategies and four aims that includes to “Sustain the vigour, diversity and successional development of the park’s plant and animal communities by ecological burning on the basis of current and future research findings” (Parks Victoria 2002, p. 20);

  - States that planned burning in WPNP is primarily done for ecological reasons as a result of the fuel management zoning. The FMZ Special Flora and Fauna Management78 takes up most of the park (see previous Figure 5.5);

- **WPNP Environmental Action Plan 2003**

  - Primary objective is to assist with ecological management by providing a guide for the conservation, improvement and protection of the park’s natural values (Parks Victoria 2003);

  - Comprises three main components: 1) a detailed overview of the natural values present in the park including historic information obtained from a range of sources as well as tacit knowledge of park staff; 2) a report on risk factors that impact on the natural values; and 3) an action plan or work program for areas of focus;

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78 This is one of the five FMZs described in the first Code of Practice from 1995 (Stoner 2007). When the Code of Practice was revised in 2006, the FMZs were amended to the four described in section 5.3.1.
- Lists ecological burning as a requirement, achieved by completing a fire ecology assessment;

- Prescribed or individual burn plans
  - Local level, detailed document for an individual proposed planned burn. Although the area to be burnt is decided upon at a district level, the preparation of burn plans is undertaken at a park level;
  - A local staff member is in charge of a burn plan and assesses when conditions are right for a burn to take place (D Nugent & A Graystone 2010, pers. comm. 15 March). Conditions that affect the decision to go ahead with a planned burn on the actual day include the fuel level and fuel moisture, the landscape, the objective of the burn, and the weather (Department of Sustainability and Environment 2010a);
  - Requirements for burn plans are outlined in the *Code of Practice*.

5.3.2.4 Other data, information and tools

Behind the key documents outlined lies a variety of other data. These can provide background to the documents, may be needed to produce them or can be assistive tools. For instance, a variety of data aims to assist with the development of an FEA or provide background details. Accessible through Parks Victoria's InfoWeb, these include:

- A user’s guide to flora monitoring protocols for planned burning and an associated report;
- An ecological fire planning kit comprising a number of documents including the *Ecological Burn Strategy – Practitioner’s Manual* itself;
- Case studies and draft burning strategies, tools and ‘how to’ guides including how to calculate ideal distributions (relates to flora) and a key fire response species databases; and
- References and research documents.

Another example is data required for the production of an individual burn plan. Information the burn plan must contain as defined in the *Code of Practice* includes:

- Existing details about the proposed burn area such as the primary vegetation, land tenures, roads and fire history as well as information about ecological, cultural and other assets. These include the occurrences of rare, threatened or fire sensitive

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species and vulnerable habitats, or indigenous and other cultural values and neighbouring private properties that require protection; and

- Information related to the actual fire and its management such as control lines, contingency plans, nearby water supplies, assembly areas and potential escape routes, traffic and smoke management, resources required, people or agencies that need to be contacted and technical details such as the ignition method and lighting pattern (Department of Sustainability and Environment 2006).

The remainder of other data that have been encountered during the investigation is listed in Appendix III. The spreadsheet outlines the core of the key and background fire management data stored, utilised or required. It includes documents previously described in sections 5.3.2.1 through to 5.3.2.4, the background data used to develop some of these key fire management documents as well as data that are mentioned in these documents but are not necessarily used. If they were applicable to a particular document, such as the FEA or a burn plan, this is also listed. Appendix IV is a rearrangement of the data by type – from paper documents to GIS files, maps, databases and information systems.

Apart from these explicit data, a fire manager when making decisions also relies on his or her tacit knowledge, gained overtime through experience. Although outside the scope of the case study, Chapter 3.2.2 briefly described how such tacit knowledge could potentially be captured.

5.3.2.5 Accessing existing data

Chapter 4 described Parks Victoria’s key information systems, and most key fire management related data are accessed via these same systems.

InfoWeb is the initial digital access point for fire management related information with links to data in folders on the Parks Victoria network – such as the data supporting FEAs described in section 5.3.2.4 – or on governmental websites like DSE’s or the Victorian Legislation site. The DSE website generally holds the most recent versions of key governmental policies and strategies. Only limited information specific to fire management is available from Parks Victoria’s own external website apart from informative guides. ParkWeb however does give access to specific organisational
documents such as annual reports and park management plans including the 2002 WPNP Management Plan.

InfoWeb also provides shortcuts to applications like FireWeb and ParkView. FireWeb – described in more detail in 5.3.2.6 – is DSE’s key information system for fire management and planned burning. ParkView, the map based information system, gives access to natural and cultural values information. As such, the system is particularly useful for ecological requirements and to assess, for example, which flora or fauna types exist in an area to be burnt. Non-GIS users also use ParkView to view GIS data in map form whereas GIS users can access the raw GIS data files themselves that are stored on a corporate computer drive.

Several corporate computer drives host a range of data, generally organised in appropriately named folders. Apart from the GIS data, imagery is stored here as well as data belonging to different work or project groups (J Wotton 2009, pers. comm. 10 September). A folder named ‘Fire Ecology’ contains almost 40 sub folders that house fire ecology related data covering a range of areas and topics. Examples of data include meeting minutes, presentations, assessments and other documents related to specific projects or groups. A large proportion of these data was not encountered anywhere else, and can essentially only be found by going through the folders or completing a computer search using key words (and presuming this returns appropriate results). The data on these drives seemed to be accessible to all staff. Although it is possible to limit access to a folder, most people do not set such limitations (J Wotton 2009, pers. comm. 10 September).

TRIM, the record management system, houses records of official data. Any local data regarded as official records are added to TRIM, which is adhered to at WPNP (J Whelan 2011, pers. comm. 23 February). However, some local data may not be recorded in TRIM for different reasons. For example, their owner did not regard them as requiring an official record, or the data could be historic, have not been used recently, and hence have not been added to TRIM (yet). Examples of local data encountered at WPNP that are potentially relevant to planned burning but are not recorded on TRIM include research plots in progress (although they should become official record once results are in or the project finished), and long-term weather data recorded daily at two locations in the park (J Whelan 2011, pers. comm. 23 February).
5.3.2.6 FireWeb

FireWeb is the key information system for fire management information managed by DSE (Department of Sustainability and Environment 2011d) and accessible by partner agencies like Parks Victoria and the CFA. It provides access to a vast array of information including planned and current burns, maps, weather details, reports, research papers and fire suppression related information like training, equipment and health and safety. Staff members involved in fire management activities can access additional tools and information using a log-in. FireWeb essentially provides access to traditional, expert information considered important and needed for fire management activities, including ecological planned burns. Figure 5.6 displays the opening page of the FireWeb system.

Figure 5.6 - Screenshot of opening page of the internally accessible FireWeb system.


Individual burn plans are recorded and maintained in FireWeb and approval for the various stages of a plan is also obtained through the system. It further displays all planned burns listed on all FOPs. Figure 5.7 is a screenshot taken in March 2011 that
shows four ecological burns planned for WPNP that appear on the South Gippsland FOP. The top one - the planned burn for the Little Creek Track - has a ‘planned’ status, which means it has a burn plan developed for it and the burn is due to take place soon. In this instance, it was planned for the autumn of 2011 and would become the focus for the demonstration prototype.

A fire management meeting in February 2011, attended by members of the WPNP Fire Ecology Working Group comprising primarily local and district Parks Victoria and DSE staff, discussed preparatory aspects for this ecological planned burn. For instance, a tool to calculate the Forest Fire Danger Index (FDI) was utilised (the tool is accessible in FireWeb after user log-in only). The tool can estimate the behaviour of a fire under a set of conditions including temperature, wind speed, drought factor, the relative humidity, fuel load and ground slope (*FOREST FDI's - Fire Behaviour Relationships* n.d.). Using a forest fire danger rating devised by McArthur in 1973, it predicts the predicted flame height, the rate of spread of the fire, and the average spotting distance if a fire were to burn under the conditions of the input parameters. Input and output as well as the tool itself, are necessary information for the planning and conducting of burns.

Figure 5.7 - Four prescribed burns showing in FireWeb that are planned for WPNP.
5.3.2.7 Consultation with others

The third question encapsulated by the investigative framework regard consultation with others. As previously mentioned, Parks Victoria is tied to DSE for the ecological and fire management of its parks due to the DSE’s legislative responsibilities outlined in the *Forests Act* 1958 and the *National Parks Act* 1975. The two organisations therefore consult and work together at all levels and at all times as a matter of standard practice.

The planning process for the Gippsland FPP requires DSE to consult with park specialists in areas like flora, fauna, forests, cultural and heritage values, and fire management, which include Parks Victoria staff. Furthermore, consultation with the CFA, local governments, and other agencies and stakeholders with an interest, as well as the community needs to take place (Department of Sustainability and Environment 2010e). An FOP is similarly developed in consultation with Parks Victoria, the CFA, technical specialists within DSE, local governments, the community, and other stakeholders (Parks Victoria and Department of Sustainability and Environment 2009). Other stakeholders consulted with at various stages can include divisions within the Department of Primary Industries (DPI) such as those involved in fisheries or agriculture, VicForests, Catchment Management Authorities (CMAs), Water Authorities and cross border agencies like the South Australian and New South Wales fire services (Department of Sustainability and Environment 2008b).

DSE and Parks Victoria may consult with experts from universities and other agencies, for example when developing landscape mosaic burns (Department of Sustainability and Environment 2009a). These burns achieve a variety of burn intensities in a landscape through different burn methods, and are regarded as more efficient. They have been developed to meet ecological objectives as well as human and asset protection objectives (Parks Victoria and Department of Sustainability and Environment 2009).

Because fire management is effectively a partnership between Parks Victoria and DSE, both organisations consult with the same agencies and people, except for communication at a local park level perhaps. Which people and organisations are consulted varies depending on the perceived impact and other circumstances (Department of Sustainability and Environment 2008b). In summary, these are:

- CFA;
- Internal and external experts within DSE and Parks Victoria and other organisations such as universities and other land, park or fire management agencies;
- Stakeholders and other interested parties including DPI, VicForests, CMAs, municipalities, water agencies, license holders such as apiarists, plantation owners and tourism organisations, neighbouring land owners, and representatives for European and Indigenous cultural heritage; and
- The community.

Consultation at a local park level involves consultation with similar groups at various points. As aforementioned, all management plans have draft versions and the community and other stakeholders are consulted before the management plan is finalised. The same applies more or less to planned burns, because activities and processes involved with planned burning are developed in collaboration with the community (Department of Sustainability and Environment 2006). If any cultural values fall within a specific burn area, a Cultural Heritage Coordinator also needs to be consulted. This is because the heritage information provided by Aboriginal Affairs Victoria and accessible through ParkView for instance is broad only, hence more precise details are needed for specific burning (Stoner 2007).

Other people to be communicated with locally for planned burn activities are:
- Relevant water authorities if burns are taking place near catchment areas;
- Local governments and the police;
- Neighbours and local landholders (D Nugent and A Graystone 2010, pers. comm. 15 March);
- Other agencies and stakeholders like tourism agencies and operators, licensed forests operators or beekeepers near the area to be burned;
- Road management authority, for example in relation to closed roads and access (Department of Sustainability and Environment 2006); and
- The local media, particularly in relation to smoke (Department of Sustainability and Environment 2008a).

5.3.3 Overview of data needs and decision process for planned burns

Having investigated the data requirements and decision processes for fire management and planned burns, the decision-making process for an individual, ecological planned
burn can be visualised. Figure 5.8 visualises the generalised process, from legislative and organisational requirements to input on the day of lighting the burn.

Figure 5.8 displays the cascading framework in place, and shows that legislation and corporate and regional key documents, combined with other data as well as consultation with other people are all part of the process. These combined are the essence of the GKT to which other, non-traditional data can be added.

The demonstration prototype to be developed focussed on the preparations of an ecological planned burn at a local level, and particularly the data requirements. This is described in more detail in section 5.7.

5.4 Alternative data sources

One of the research questions asked if alternative data could be amalgamated with traditional data – that is, Parks Victoria’s existing data archive – to form part of an effective knowledge tool. The next activity of the case study therefore looked further into these non-traditional data sources, with a particular focus on existing data
accessible via the Web. This was because data in the New Web era are provided via the Web by experts and non-experts alike, with digital data repositories made available by organisations such as governments, news companies and libraries as well as the general public and other non-traditional data providers through participatory and collaborative Web tools and applications like blogs, wikis and media sharing sites.

There also appeared to be a general trend towards the digitisation of existing archives by relevant institutions, thus making these data more easily accessible to a larger audience. For example, in line with "an accepted practice of collecting institutions all around the world" (National Archives of Australia 2012, para. 1), the National Archives of Australia started digitising selected records held in their collections in 2001 resulting in over 23 million at the date of writing. A special digitisation service launched in 2007 means records can be digitised on demand (National Archives of Australia 2012). The ABC commenced digitisation of its entire radio and film archive in 2005 (Gedda 2005), whilst the National Library of Australia began digitising newspapers that were out of copyright in 2007. It did so in partnership with State and Territory libraries and at time of writing, over 5 million newspaper pages and 30 million articles have been digitised (National Library of Australia 2012). And in 2011, in the United States, the National Academic Press made over 4000 of its publications available for free download (Murphy 2011).

Data made available digitally to the public, for free or not, is increasing – in an informal manner through participatory tools and application and more formally through reputable institutions, as the previous examples showed. It arguably makes sense to assess if any of these data can potentially benefit an organisation’s own data as the research project proposed.

5.4.1 Potential alternative data sources for the geo-knowledge tool

Figure 5.9 is a revised version of the figure previously shown in the Introduction chapter that now centres on WPNP. It shows a variety of data sources that the GKT could draw on that includes traditional Parks Victoria data and potential alternative data sources. These non-traditional data can be obtained from digital data repositories made available on the Web by organisations and individuals, professionals and amateurs alike. They can also be data sourced from individual parks and departments; data that
have not traditionally been accessible by or relied upon by Parks Victoria staff outside of those areas. The figure’s elements are briefly explained, with some expanded upon using examples of findings of the investigation as appropriate.

1. WPNP local data – Created by and/or existing at WPNP and often not accessible by or known to people other than those involved in the data’s creation or colleagues working nearby. Examples encountered include:
   - Long-term weather data, recorded daily for two locations: Tidal River and Yanakie. Recordings taken include temperature and rainfall, which are used to calculate the Fire Danger Index needed to assess whether the prescriptions for a planned burn are met;
   - Details about trapping and baiting programs conducted in the park;
   - Information about research plots while the research is not finalised\(^{80}\);
   - Maps and records depicting past slashing activities conducted at WPNP. Although only very few people know of their existence, these existing maps and records can assist potential management issues and enable more informed decisions on, for example, how to manage degraded areas (J Whelan 2011, pers. comm. 23 February);

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\(^{80}\) Once the research is finished and findings are known, it becomes an official record and is added to TRIM (J Whelan 2011, pers. comm. 23 February).
2. Parks Victoria corporate data – Organisational data accessible via various information systems. These are traditional data relied upon and generally accessible by all staff (legitimate restrictions permitting);

3. Data from other Parks Victoria parks and departments – Essentially the ‘local data’ of other parks or departments, and like WPNP’s local data, often not accessible by or known to most staff. An example encountered is the data collection of the current Parks Division, and particularly its research staff. The data are stored in a staff kitchen on the ninth floor of the organisation’s Head Office in Bourke Street, on shelving covering two walls. Anyone that visits the collection’s physical location can access it and take an item. Issues concerning the data include:

- Regional Parks Victoria staff members generally do not know about the collection’s existence, but neither may staff members working at the Bourke Street office if they have no business visiting the kitchen in question;
- A Microsoft Access database exists that shows details of the stored files, however, only limited people have access to this database;
- The database has two locational identifiers that indicate where files are stored. However, because the library is open access, files can be taken and put back in incorrect locations;
- The data are generally organised by topic or by type – for example, reports of the Land Conservation Council, journals, visitor research reports and research projects in collaboration with universities. Therefore, data relevant to WPNP that may be contained within any of these files are not necessarily easily found. Some data are stored under the topic of ‘WPNP’, including previous park management plans;
- A search in the database for ‘fire’ and ‘fire management’ returned 121 records and included internal research reports and reference material. Some of these were previously encountered during the investigation into data requirements described in section 5.3.2, whilst most were not;

4. Data at Parks Victoria’s predecessors – Data from the organisation’s predecessors – Parks Victoria was formed in 1996 (Parks Victoria 2007) – is held by DSE with only important documents transferred to Parks Victoria at the time (J Wotton 2010, pers. comm. 7 June). The content of DSE’s library is not freely accessible to Parks Victoria staff, although DSE has an online catalogue accessible to the public via
A search of this catalogue for ‘Wilsons Promontory’ and ‘ecology’ returned 18 results, whilst ‘Wilsons Promontory’ and ‘fire’ gave 11 results including a 1906 microfiche file by the Geological Survey of Victoria. Apparently, boxes with data from fire related research from the 1970s that is potentially valuable for current fire ecology management at WPNP are stored in a regional DSE office (D Matthews 2011, pers. comm. 15 February). These may be difficult to find through DSE’s library catalogue however, if findable at all, unless going through the physical collection at the location they are stored. Although important documents were passed on at the time, perspectives could change or differ about what is relevant and what is not as the uncovered boxes suggest;

5. **Expert data from other park management / natural environment organisations** – Refers to organisations like Parks Victoria that are involved in park or natural environment management such as other state or international agencies, as well as organisations like the IUCN and Parks Forum, both peak bodies in this field;

6. **Expert data from other (non-park) organisations** – Refers to organisations that have their own area of expertise that could be relevant to Parks Victoria, like knowledge management or human resources;

7. **Existing public data repositories** – Media organisations, governments and state libraries for example are making information available on the Web. Some have made at least part of their data available online for easy access (described in more detail in the next section);

8. **Data contributed by the general public, Data contributed by stakeholders / interest groups, and Data contributed by park visitors** – These three would be the result of adopting Web 2.0 concepts that allow park visitors, staff or the general public to contribute information where they traditionally may not have been able. This could be via (existing) Web based tools and applications available on computers and mobile devices, or through crowdsourcing projects. Stakeholders or interested groups could include friends of the park groups, trail bike riders, or recreational fishermen that use the park; and

11. **Tacit knowledge of WPNP staff** – Expert knowledge of WPNP staff and in part associated with 1: local data at WPNP.

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Although data sources 5 through 10 in Figure 5.9 above are identified as separate potential data sources – based on ‘who’ contributes the data - they effectively all are existing public data repositories. For example, blogs, wikis and media sharing sites are digital repositories of user contributed photos, videos, opinions or observations, whilst expert data from other park / natural environment organisations and from other (non-park) organisations are also potentially found on the Web through organisational websites, digital journal repositories or other public archives.

5.4.2 Potentially relevant data on the Web

Of course, a vast number of websites or digital data repositories exists and many of these can potentially be useful. The case study topic of ecological planned burning at WPNP comprises both overarching and subtopics such as WPNP, fire management, park management, natural environment, flora and fauna. The investigation into potentially relevant existing digital archives therefore focussed on ones that cover some of these related topics. To stay within the scope of the research project and to make the task doable, only a small number of websites was looked at relative to the number that exists with the aim of providing a general summary of potentially useful information. Should Parks Victoria decide to develop the GKT or apply the concept that existing data archives could benefit the organisation’s own data, a more in-depth and focussed search on the organisation’s topics or areas of interest would need to be conducted.

Following are examples of websites that house digital data repositories made available by organisations, individuals, experts and non-experts, and ranging from reports and white papers to photos, videos, personal experiences and feedback comments. Some sites were chosen because they represent well-known sites (for example Flickr and YouTube), are known to be major Victorian or Australian information providers in general (for example the ABC and State Library of Victoria), or are organisations known to be relevant to park management (for example the IUCN). The remainder were encountered when searching the Web. Combined, they aim to represent a variety of different types of data sources (websites) and data offered.

The websites are divided into five main groups: news and media sites; social media and (collaborative) reference sites; libraries and museums; park management and natural environment related sites; and fire and fire management related sites. The organisation, website address and a brief description are provided.
News and media sites:

- ABC (www.abc.net.au) – The Australian public broadcast organisation;
- The Age (www.theage.com.au) – A daily newspaper published in Melbourne;
- Australian Geographic (www.australiangeographic.com.au) – Online version of paper based magazine with a primary focus on geographical related articles about Australia.

Social media and (collaborative) reference sites:

- Flickr (www.flickr.com) – A photo-sharing site;
- YouTube (www.youtube.com) – A video-sharing site;
- OpenStreetMap (www.openstreetmap.org) – An open source mapping project and platform created and maintained by volunteers in a collaborative manner;
- Bushwalking blog (bushwalkingblog.blogspot.com) – A personal blog describing personal experiences of various bushwalks undertaken including some in WPNP\(^2\);
- Ecology related blog (dougbeckers.com) – A personal blog maintained by a professional ecologist based in the State of New South Wales\(^3\);
- Directory of Open Access Journals (www.doaj.org) – Access to full text scholarly and scientific journals covering a variety of fields and topics;
- GoogleScholar (scholar.google.com.au) – Search tool for scholarly and scientific literature from a range of sources, covering a wide variety of fields and topics;
- BioOne (www.bioone.org) – A database for research and journal papers in the biological, ecological, and environmental sciences established through a global, not-for-profit collaborative initiative.

Libraries and museums:

- State Library of Victoria (www.slv.vic.gov.au) – Provides an online catalogue to search its archive, with some items available online;
- National Library of Australia (www.nla.gov.au) including its search engine Trove (trove.nla.gov.au) – Trove is a search tool established with collaboration of major

\(^{2}\) The blog has various references to Parks Victoria’s website. For example, the post on the Brimbank Park nature trail states that the map available via the website is not very good, which Parks Victoria could use to update and improve the available Brimbank Park map. Refer bushwalkingblog.blogspot.com/2009/02/brimbank-park-nature-trail-brimbank.html.

\(^{3}\) One of the posts discusses the New Holland Mouse, a rare fauna species that is also present in WPNP.
Australian libraries, and provides access to material from sources not available through other search engines;

- Museum Victoria Bioinformatics Project (museumvictoria.com.au/bioinformatics) – An interactive site to search for fauna related information including images and locations and years of sightings. Museum Victoria also provides online access to some of its collections and research, one of which is the Victorian Bushfires Collection of 2009. The collection has 234 items including audio-visual material, documents, images and photos of objects\(^{84}\).

**Park management or natural environment related sites:**

- IUCN (www.iucn.org/knowledge/) – Site provides online access to publications and a range of other information and resources;
- eBird (ebird.org) – Online database of bird observations providing scientists, researchers and amateur naturalists with real-time data about bird distributions;
- Atlas and Birdata (www.birdlife.org.au/projects/atlas-and-birdata) – A collaborative monitoring project for tracking changes in birds, organised by Birdlife Australia\(^{85}\);
- Victoria Naturally Alliance (victorianaturally.org.au/index.php) – Access to publications and white papers. Exists of nine environmental groups, most deemed respectable and headed by the Victorian National Parks Association (VNPA);
- The Victorian Naturalist (www.fncv.org.au/vicnat.htm) – Scientific journal publication that is not yet fully available online but should be in future. Although membership is required to access full journal articles, abstracts are accessible as well as other reports;
- Atlas of Living Australia (www.ala.org.au) – A collaborative and evolving website that aims to link data and information related to Australia’s biodiversity from different sources, to make them more accessible and usable online;

The Australian Government and particularly the Department of Sustainability, Environment, Water, Population and Communities, have a variety of digital search tools and data archives relevant to park management. Of particular relevance to park

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\(^{85}\) Birds Australia commenced the Atlas and Birdata project in 1998. The organisation merged with Bird Observation & Conservation Australia in 2012 to form Birdlife Australia.
management are two relating to the *Environment Protection and Biodiversity Conservation Act*, which are:

- Protected Matters search tool (www.environment.gov.au/epbc/pmst/index.html) – Online tool to generate an overview of all flora and fauna species related to a particular area and emails that to the user in a PDF file.;

**Fire management related sites:**

- Bushfire Cooperative Research Centre (CRC) (bushfirecrc.com) – Access to research documents, publications and presentations from past conferences, and details on how to find information not available via the site;
- Australian Fire and Emergency Service Authorities Council (AFAC) Knowledge Web (knowledgeweb.afac.com.au) – Online access to a range of reports and publications, with more detailed information accessible to affiliated organisations only (Parks Victoria is eligible);
- Bush Fire Front (bushfirefront.com.au) – Access to papers and opinion pieces on fire management and planned burning related topics. Site regards itself as a ‘small, independent, think-tank’ that focuses on enhancing protection of brushfires in Western Australia;
- Argus (fireweb.dse.vic.gov.au/argus/dms/welcome) – Online, collaborative learning and monitoring tool for fire and biodiversity;
- Rocky Mountain Research Station (www.treesearch.fs.fed.us/pubs/25934) – Research and development arm of the US Forest Service with access to research publications including on fire management related topics.

In an attempt to assess what potentially useful data exist on the Web, a search was completed on a selection of broader sites from the above examples and on other organisational websites, using a number of relevant keywords. Table 5.1 shows the results of those searches in alphabetical order of organisation. The search results shown are for the full, exact terms (for example ‘fire ecology’ and not ‘fire’ and/or ‘ecology’).
In some instances inverted commas (" ") were required for exact terms, whereas some sites did not allow these. The figures were obtained on 21 October 2011.

The figures in Table 5.1 initially confirm that potentially useful alternative data exist. However, the numbers mean little without a sense of the quality or usefulness of the data that can be retrieved. The issue of data quality was identified earlier in Chapter 2, and springs to mind when looking at the figures in this table. Encapsulated already by the use of the word ‘potential’ perhaps, just because articles, papers and images about fire management or controlled burning are available, does not mean they necessarily benefit the existing data archive. The research project therefore developed an assessment model – described as a confidence ratings system – that aimed to provide a method for attaching indicators to these resources as to what potential quality can be expected. The theoretical methodology for a confidence rating system considers potential quality and usefulness of data, and is described in detail in section 5.6.3.

5.5 Alternative data source: park visitors and Web 2.0

The previous Figure 5.9 (see page 157) listed park visitors as an example of an alternative data source, because they are a group of people interested in parks that can contribute potentially useful information. This can be through the contribution of digital content via blogs or photo-sharing sites by uploading images of their stay for example, or it can be whilst visiting a park. WPNP contains large areas of remote and natural country that are difficult to access on a regular basis. Park managers are often unable to monitor these areas at a frequency that would enable sound management decisions. However, park users visit some areas on a semi-regular basis. Therefore, if managers were able to involve visitors to collect and contribute information through active or passive means (Turner and Forrest 2008), these contributions could potentially enhance exiting information and knowledge.

5.5.1 Park visitor survey

To assess what the potential value of park visitors as an alternative data source was, the research project conducted a visitor survey at WPNP. The aim was to gain an insight into the perceived willingness of park visitors to participate and contribute
Table 5.1 - Number of results found on selected websites using a range of keywords deemed relevant to the case study. Date obtained 21 October 2011.

<table>
<thead>
<tr>
<th>Website</th>
<th>Fire ecology</th>
<th>Park management</th>
<th>Fire management</th>
<th>Controlled burning</th>
<th>Flora</th>
<th>Bushfire</th>
<th>Wilsons Promontory</th>
<th>Natural environment</th>
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<tr>
<td>ABC</td>
<td>0</td>
<td>27</td>
<td>64</td>
<td>10</td>
<td>72</td>
<td>3,954</td>
<td>44/9*</td>
<td>3</td>
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<td>ABC Gippsland</td>
<td>1</td>
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<td>4</td>
<td>0</td>
<td>8</td>
<td>175</td>
<td>26/11*</td>
<td>8</td>
</tr>
<tr>
<td>AFAC Knowledge Web</td>
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<td>3</td>
<td>105</td>
<td>12</td>
<td>31</td>
<td>2,262</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>The Age</td>
<td>18</td>
<td>31</td>
<td>91</td>
<td>29</td>
<td>1,076</td>
<td>3,475</td>
<td>236/37*</td>
<td>342</td>
</tr>
<tr>
<td>The Australian</td>
<td>2</td>
<td>128</td>
<td>117</td>
<td>119</td>
<td>549</td>
<td>3,557</td>
<td>74/73*</td>
<td>331</td>
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<tr>
<td>Australian Geographic</td>
<td>189</td>
<td>404</td>
<td>225</td>
<td>211</td>
<td>51</td>
<td>44</td>
<td>12/36</td>
<td>499</td>
</tr>
<tr>
<td>BioOne</td>
<td>121</td>
<td>118</td>
<td>292</td>
<td>81</td>
<td>6,446</td>
<td>13</td>
<td>18/8*</td>
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<tr>
<td>Bushfire CRC</td>
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<td>3</td>
<td>341</td>
<td>9</td>
<td>13</td>
<td>1,335</td>
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<td>2</td>
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<td>619</td>
<td>26</td>
<td>1,120</td>
<td>496</td>
<td>23/29*</td>
<td>570</td>
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<td>IUCN</td>
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<td>298</td>
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<tr>
<td>Flickr</td>
<td>191/101^</td>
<td>622/253^</td>
<td>1,628/1,875^</td>
<td>12,069/80^</td>
<td>&gt;1 million</td>
<td>27,940/12,543^</td>
<td>8,759/2,824*</td>
<td>13,075/1,346^</td>
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<tr>
<td>Google Scholar</td>
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<td>19,300</td>
<td>36,400</td>
<td>9,060</td>
<td>&gt;1 million</td>
<td>9,840</td>
<td>1,240/1,190*</td>
<td>&gt;1 million</td>
</tr>
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<td>State Library of Victoria</td>
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<td>31/132**</td>
<td>58/165**</td>
<td>0</td>
<td>403/1,929**</td>
<td>98/332**</td>
<td>231/371 / ** *</td>
<td>168/214 **</td>
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<td>7,831</td>
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<td>46,099</td>
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<td>0</td>
<td>30</td>
<td>18</td>
<td>6</td>
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</tr>
<tr>
<td>Weekly Times Now</td>
<td>3</td>
<td>7</td>
<td>101</td>
<td>8</td>
<td>172</td>
<td>3,170</td>
<td>140/8*</td>
<td>72</td>
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<td>YouTube</td>
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<td>231</td>
<td>249</td>
<td>123</td>
<td>121,000</td>
<td>3,980</td>
<td>458/71*</td>
<td>42,100</td>
</tr>
</tbody>
</table>

* Results are given for two spellings “Wilson’s Promontory” and “Wilson’s Promontory” (for example 44/9 is 44 without apostrophe and 9 with).
^ Results are presented as full text results versus tags results (for example 191/101 is 191 results for full text search and 101 for tag search).
# Order of these results is full text results Wilson’s spelling/Wilson’s spelling on top line and tags results (Wilson’s spelling only) on second line.
** Results are presented as those available online versus all available results (for example 15/97 is 15 accessible online of 97 total results).
## Order of these results is accessible online/total results for Wilson’s spelling on top line and Wilson’s spelling on second line.
information for the benefit of the park or to assist park managers, and thus assess what the opportunities were for involving park visitors in crowdsourcing projects or obtain information from them through participatory tools.

The visitor survey took place during the Victorian school spring break over three days in late September 2010. A total of 83 people completed the questionnaire, which considering the season and weather as well as type of questionnaire that required people to sit down in order to complete it, was regarded as a positive outcome. The participants were recruited using a direct approach; as they were passing a central area of the park that comprises a café, supermarket and seating, they were stopped and invited to complete the survey on the spot. Because visitor numbers are limited during that time of year, all adults that passed the area were approached, and bar two or three, everyone agreed to participate.

There were 17 main questions categorised as ‘General’ (questions 1 - 5), ‘About Web 2.0’ (questions 6 - 13) and ‘User experience/information needs’ (questions 14 - 17), whilst four open questions under the header ‘About your stay at Wilsons Promontory’ completed the questionnaire (see Appendices VI and VII for a copy of the questionnaire and the accompanying explanatory letter).

5.5.2 Visitor survey results

Following are the results for the four sets of questions. Please note that although there were 83 participants, not all participants answered all questions. The number of responses to each question is listed and it can generally be inferred that the remaining respondents did not answer that question.

5.5.2.1 Responses to ‘General’ questions 1-5

The first two questions asked about age group and gender. There were 49 female and 34 male participants, who were divided into four age groups as shown in Table 5.2.

The fact that the youngest and oldest age group are slightly underrepresented is somewhat linked to the period chosen to conduct the survey: a primary and secondary school holiday for Victoria. People who do not have school age children would seem more likely to choose another time to visit the park to avoid busy accommodation and higher prices.
<table>
<thead>
<tr>
<th>Age group</th>
<th>Total # of participants</th>
<th>Gender division</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 30 years old</td>
<td>10</td>
<td>5 females / 5 males</td>
</tr>
<tr>
<td>31 – 45 years old</td>
<td>30</td>
<td>19 females / 11 males</td>
</tr>
<tr>
<td>46 – 60 years old</td>
<td>25</td>
<td>15 females / 10 males</td>
</tr>
<tr>
<td>61 years old and over</td>
<td>18</td>
<td>10 females / 8 males</td>
</tr>
</tbody>
</table>

Table 5.2 - Division of survey respondents by age and gender.

The next question asked if people used the Internet, and if they did, if they were familiar with Web 2.0 tools that were described in an accompanying explanatory letter. Of the 83 respondents, 78 used the Internet with 59 of these 78 (76%) aware of or familiar with Web 2.0 tools. Ninety per cent of the participants from the 18-30 age group knew about Web 2.0, as well as 77% of 31-45 year olds and 71% of 46-60 year olds, while only about 50% of people aged over 60 was aware of the Social Web developments. Figure 5.10 shows the division in age group of the Web 2.0 awareness of the survey participants.

![Figure 5.10 - Web 2.0 awareness by age group.](image)

For people who were familiar with Web 2.0, the remainder of the question asked which, if any, of a series of social media tools or applications they used. The choice of applications represented well-known and arguably popular sites with an ‘Other’ option for those tools not offered as a choice. The 65 responses received showed that *YouTube* and *Facebook* had the highest number of users (45 and 40 respectively), followed by wikis (25). The micro-blogging application *Twitter* had only seven users, outsourced by

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86 This is somewhat in line with more recent social media usage statistics, as described earlier in Chapter 2.2.4, that also puts *YouTube* and *Facebook* as the top two applications used by Australians, although in reverse order (*Facebook* first, and *YouTube* second) (Cowling 2011).
feedback forums (10) and blogs in general (9), whilst there were three Flickr users. Picasa, SmugMug, MobileMe and Google Earth were the remaining applications mentioned through the ‘Other’ option, with minimal users each (see Figure 5.11). Ten of the 65 respondents answered that they did not use any Web 2.0 tools or applications.

![Figure 5.11 - Number of users for selected key social media tools and applications.](image)

The majority of the 55 respondents who did use social media tools used either two (19) or three (14) applications, whereas 10 indicated they only use one application (the remaining people used between four to seven different applications). The most common combination was YouTube and Facebook with wikis added for the people who used three applications. The youngest age group, 18-30, used the most applications per person. Each member of this age group who had responded to the question and did use the tools used 3.9 applications on average. This dropped to 2.3 for the 31-45 age group, two for the 46-60 age group and 1.87 for the people 61+ age group.

A slight variation could also be observed for each age category and the actual tools used. Blogs, for example, were mostly used by people under 46. Only one person in the 61+ age group used blogs and no one in the 46-60 age group did. Wikis and feedback forums however were more used by the 46-60 year olds, with the number of people using wikis matching the number of people using Facebook (10 each), while five used feedback forums, which was half of all feedback forum users. Finally, the respondents in the oldest age group, 61+, were the only group that used Facebook (7) more than they did YouTube (3). In the three other age groups, YouTube beat Facebook.
The next question asked if people used the Internet on mobile devices, and if yes, on which device and if it was wireless enabled. Thirty-six out of 83 people responded that they did use the Internet on a mobile device with 31 of these 36 wireless enabled, but only half (18) replied which device that was. The iPhone was the most popular (6), followed by a mobile phone in general (5), a laptop (3) and a Blackberry (2). Two others mentioned an iPad and a smartphone.

The final question in the ‘General’ category asked what type of park related information people were generally interested in. Nine options were available through tick boxes. The vast majority of the 82 people that answered ticked multiple boxes. The responses in order of most ticked are shown in Table 5.3.

<table>
<thead>
<tr>
<th># of responses</th>
<th>Park information of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>Bushwalking/short walks (one day or less)</td>
</tr>
<tr>
<td>66</td>
<td>Natural/geographic features such as waterfalls, lookouts etc.</td>
</tr>
<tr>
<td>66</td>
<td>Nature (flora/fauna)</td>
</tr>
<tr>
<td>53</td>
<td>Cultural features, such as historic sites, aboriginal sites, art etc.</td>
</tr>
<tr>
<td>48</td>
<td>Camping</td>
</tr>
<tr>
<td>46</td>
<td>Hiking/trails (more than one day)</td>
</tr>
<tr>
<td>23</td>
<td>Water sports such as surfing, fishing, kayaking, diving etc.</td>
</tr>
<tr>
<td>9</td>
<td>Other, please specify</td>
</tr>
<tr>
<td>3</td>
<td>None in particular</td>
</tr>
</tbody>
</table>

Table 5.3 - Number of responses for nine park related information types of interest to people.

Although the question asked about general interest, it is feasible that the season in which the survey was conducted (early spring and generally cold) may have influenced some of the responses. For example, the water sports option may well get a bigger response in the height of summer. The responses to the camping and overnight hiking options may be similarly affected. Nonetheless, it is interesting to observe the relative low interest in camping, although this is a key aspect of a trip to WPNP with fixed accommodation options limited in numbers compared to the available camping space. However, some people may regard this as a necessity; just part of it or something you do rather than a particular area of interest.
The additional comments noted by the nine people who ticked the 'Other' box included running, children’s activities and safety.

5.5.2.2 Responses to ‘About Web 2.0' questions 6 - 13

The first question in the category ‘About Web 2.0', question 6, asked what the person’s opinion was of the concept of Web 2.0. There were nine possible answers provided. Three of these were clearly positive and the remainder negative or neutral, with multiple ticks allowed. Sixty-four out of 79 respondents chose at least one positive answer, with 45 of these 64 giving only positive answers and 19 a combination of positive and negative answers. Fifteen people only ticked negative or neutral (‘I have no opinion' and ‘Perhaps more for the younger generation, but at least not for me’) options.

The two most popular answers were ‘Interesting’ and ‘Useful’ (53 each). ‘Fun’, the third positive answer, was ticked 20 times. The most dominant negative response was that it was intrusive (16), whereas nine people thought it was more for the younger generation, seven considered it just the latest trend that would pass, six thought it was all a bit exaggerated and three thought it was a waste of time (see Figure 5.12).

Not one person ticked the 'Other' box apart from using it as an opportunity to add the comment that Parks Victoria “should use/take advantage of new communication technologies”.

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interesting</td>
<td>53</td>
</tr>
<tr>
<td>Fun</td>
<td>20</td>
</tr>
<tr>
<td>Useful</td>
<td>53</td>
</tr>
<tr>
<td>Exaggerated</td>
<td>6</td>
</tr>
<tr>
<td>Waste of time</td>
<td>3</td>
</tr>
<tr>
<td>Intrusive</td>
<td>16</td>
</tr>
<tr>
<td>Just latest trend</td>
<td>7</td>
</tr>
<tr>
<td>For younger generation</td>
<td>9</td>
</tr>
<tr>
<td>No opinion</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 5.12 - Varying views on Web 2.0 by number of people.

Of the 15 people that only had negative views of Web 2.0, 12 were female and three male, representing 25% and 9% of the total number of female and male participants.
respectively. Thirteen of these 15 did use the Internet and seven were not familiar with Web 2.0. The biggest group with only negative views were females aged 31-45 (6), representing almost a third of all females in this age group. These six represented 20% of all people in this age group, while 16% of all people aged 45-60 and 28% of all people aged 61+ also had negative views only. None of the 18-30 year olds did.

The next two questions required people to indicate how strongly they agreed or disagreed with a statement (the Likert scale of five ranged from ‘strongly agree’ to ‘strongly disagree’). The first of these two questions asked whether they thought that participating on the Web could potentially be dangerous. There was no distinct division with 21 people either disagreeing (18) or strongly disagreeing (3), whereas 34 either agreed (28) or strongly agreed (6) - 26 had no opinion (two did not answer). The 34 that saw some danger comprised just under 50% of all female participants whereas less than a third of all male survey participants thought this.

The second question asked whether people would only contribute ‘safe’ information, with the results more clear-cut. Almost two thirds of people either agreed (41) or strongly agreed (13) that they would only contribute information that they did not mind being passed on or being used by others, whereas less than 10% disagreed (4) or strongly disagreed (4) with this. Eighteen neither agreed nor disagreed and three did not answer.

Question 9 asked if people would be happy to share their photographs or videos from their stay at the park through a Web based photo or video-sharing site. About 66% (51 out of 77 usable responses[^87]) would do so in principle, 18 respondents ticked the ‘no’ box whereas another eight had to think about it / needed more information. The 18 who would not participate were roughly evenly divided over the four age categories and represented female and male participants equally evenly.

Incorporated into the question were options if they would be willing to upload onto any photo-sharing site or onto a dedicated Parks Victoria/WPNP site only. The division in responses was close to 50/50. Males however were more inclined to choose any photo-
sharing site (76%) whereas 70% of females opted for a dedicated site. The other choice participants were given was uploading photos at home versus doing so at a designated computer at the park’s visitor centre. This favoured the former, with 25 out of 30 people indicating their choice would be to upload photos from home. All in all a total of 51 people indicated that they would participate in principle, whether this was any photo-sharing site, a special site set up by Parks Victoria or WPNP, from home or during their stay using a dedicated computer in a park’s visitor centre. Figure 5.13 shows the percentages of females and males of each age category that would potentially participate, as well as the percentage of the total number of people for each age group.

Figure 5.13 - Contributing photos - percentage of female, male and total respondents for each age category who would potentially do so.

With the exception of the youngest group aged 18-30, males were overall more likely to participate than females were, with the least likely people to participate women in the age group 61+ (30%) followed by their counterparts aged 31-45 (47%).

Question 10 asked if people would be likely to use Web based communication tools like a blog, feedback forum, Twitter etc. if WPNP were to use these. Thirty-four out of 80 people responded that they would, however only 10 of these 34 indicated they would actively participate themselves. The remaining 24 would only look at or read contributions by other people. Twenty-eight out of 80 gave a straight ‘no’ and 18 required more information.

Similar to the previous question, the age group 61+ again had the highest non-participants (50%). None of the youngest age group 18-30 said they would not participate (although two did answer ‘maybe’ rather than a straight ‘yes’), while 33% of
all 31-45 year olds and 36\% of all 46-60 year olds would not use such tools. Figure 5.14 shows the percentage of females and males in each age category who responded that they would potentially use Web 2.0 tools provided by WPNP or Parks Victoria.

The 34 people who would potentially use the tools comprised 18 females and 15 males. Only three out of the 18 females would contribute themselves whereas seven out of the 15 males would, again showing a tendency for males to be more inclined to participate than females. The remaining 15 females and eight males would only look at other people’s contributions. Figure 5.15 represents just the 34 people who would potentially use the tool, and what percentage of each age group and gender of those would contribute themselves or only read other people’s contributions.
Although Figure 5.15 shows that females in the two highest age groups are more willing to use the tools than any other group, none of these women would contribute information themselves (although one added the comment that she might).

Briefly comparing the non-participants in question 9 with those in question 10; 12 of the 18 people who would not upload photos would also not use the tools in question 10. Of the remaining six, three would use the tools (the other three needed more information). So 12 of the 28 people who would not use the tools in question 10 would also not upload photos, however, another 12 would potentially do so (the remaining four needed more information).

When asked in the next question how often they might participate, only seven would do so on a semi regular basis – perhaps weekly or a few times a month at least. The majority would only use these tools before or after a trip to WPNP (28 out of 55 respondents), or otherwise a couple of times a year (12) or perhaps only a few times and then no more (8). Looking at the responses of the 34 people who would use the tools in the previous question 10, only six of the 34 would participate semi-regularly (weekly or monthly). Only three of the 10 people that would contribute themselves would do so on a semi regular basis and over 50% would participate after a trip to WPNP. Of the 24 people that would only look at other people’s contributions however, only three would do so semi regularly and only nine would do so before or after a trip (the remaining twelve respondents would use them only a few times or did not answer).

In preparation for question 13, the third question that directly asked about people’s willingness to participate, question 12 firstly asked if people had a GPS enabled mobile device such as a phone or PDA. Out of 81 responses, 29 ticked ‘yes’ and 52 ticked ‘no’.

Question 13 then asked if they would be willing to carry a mobile GPS enabled device during their stay to assist park management. Fifty-two out of 80 respondents stated that they would, with 26 answering ‘no’ and 2 ‘perhaps’. Twenty-one of the 52 potential participants did not want to do anything specific for it except carry the device, whereas 27 of the 52 would be willing to put in some (minor) effort to complete the task. All 18-30 year olds would participate, but it was the 31-45 year olds that were less willing to do so this time (only 50%). 64% of 46-60 year olds and 67% of people aged 60+ would be willing to participate.
Twenty-seven of the 52 people who would in principle be willing to carry a GPS device were female, representing 55% of all female survey participants. Again, the males were more inclined to participate, with 74% of the 34 male participants willing to do so. Figure 5.16 shows the gender division as a percentage of the total number of female and male participants as well as the percentage of all people in each age category who would potentially be willing to carry a GPS enabled device to assist park management during their stay at WPNP.

![Figure 5.16](#) - Percentage of female, male and total respondents for each age category who would potentially be willing to carry a GPS device during their trip.

Additional comments received as to the perceived willingness include that they would do so as a one off and that the exercise should not require much effort. Furthermore, judging by the low number of people with GPS enabled mobile devices, Parks Victoria or WPNP would have to provide participants with such devices in the event this was to take place. This would most likely aid and streamline any such project anyhow, as all devices could be tested in advance and be ready for use with appropriate applications and accompanying instructions in place.

5.5.2.3 Responses to ‘User experience/information needs’ questions 14 - 17

The next four questions were aimed at gaining some insight into what kind of information park visitors use and where or how they obtain that information. Because georeferenced information can now be readily visualised using Web based mapping tools that include collaborative and participatory elements, and the use of maps as a result of these developments is growing, park visitors’ views on maps was also sought.
The results of these questions would particularly assist the development of the conceptual GKT.

Question 14 asked if people usually obtain information about a place they intend to visit, and if yes, how they usually obtained this information. Of the 81 responses, only two people answered that they did not find information whereas 79 said they did. The six possible answers provided for where they obtained their information, apart from 'Other', were:

a) Guidebooks or other books;
b) Beforehand, from the Internet;
c) Beforehand, through brochures and/or information from a tourist centre;
d) At destination, through brochures and/or information from the visitor centre; and
e) At destination, by accessing the Internet on a mobile device.

The 78 ‘yes’ responses received (one did not elaborate) mainly comprised a combination of answers. Answer b) - obtain information beforehand from the Internet - was the most popular and ticked 64 times, followed by answer d) (49), answer a) (43) and answer c (34). Of the 14 people who did not use the Internet beforehand to obtain information, one did tick e) and thus uses the Internet on a mobile device at destination. The remaining 13 people who did not use the Internet beforehand were predominantly in the higher two age groups: four were aged 46-60 and seven were aged 61+ (two were in the 31-45 age category). This group of 13 also included the five people who did not use the Internet at all (asked in question 3).

Only 10 out of 78 respondents included accessing the Internet on a mobile device at destination (answer e) as part of their answer (eight of these 10 previously responded that they use the Internet on their wireless enabled mobile device). A perhaps somewhat surprising outcome is that almost 37% do not use the park’s visitor centre to obtain information. Although this overall may be more an issue for Parks Victoria to consider with regards to providing appropriate information services for example, it may also be something to bear in mind if the GKT were ever to become available at a park for visitors to use and gather information.

The next question asked if people were likely to use a Web based tool that let them choose the information they were interested in and put it together as a map or other
document to take along, instead of, for example, an existing guidebook or brochure. Of the 80 responses, 52 more or less said ‘yes’, with 20 indicating they would definitely and 32 they would very likely use such a tool. Only four answered a straight ‘no’ whereas six said ‘probably not’, and 17 people indicated ‘perhaps’ (the final respondent ticked both ‘perhaps’ and ‘very likely’). Looking at total numbers, this means that almost 66% of people were very like or definitely to use such a Web based information tool while only 12% would probably not use the tool.

Male respondents were more likely to use the tool (70% of all males versus 59% of all females). The age groups 18-30, 31-45 and 46-60 have close to even percentages of possible users (ranging from 70% to 68%). Only 44% of people aged 61+ however was likely to use the tool. Figure 5.17 shows the percentages of the ‘yes’, ‘no’ and ‘perhaps’ answers for each age group.

![Figure 5.17 - Using a Web based mapping / information tool - percentages of ‘yes’, ‘no’ and ‘perhaps’ responses for each age category.](image)

The final two questions in this set focused on maps. Question 16 firstly asked if the person used maps, with 82 out of 83 responding that they did and only one male aged 61+ stating that he did not use maps. By the way, apart from the first three questions about gender, age group and using the Internet, this is the only other question that was answered by all 83 survey participants.

Question 17 asked the visitor’s general views in relation to maps and the information on them, with a choice of eight possible answers. Fifty-five people ticked a single answer only, which in order of most popular are shown in Table 5.4.
# of responses | General view on maps
---|---
28 | Maps normally show a variety of information, most of it useful (answer a);
13 | Maps are better if they are combined with other information, for example, with a brochure that explains things in writing (answer e);
7 | Maps normally show a variety of information, but only some of it is what I am after (answer b);
3 | I wish I could take a map that would only show information that is important to me (answer c);
2 | Maps are useful on their own; the symbols used help me understand what things are (answer d);
2 | I have no particular opinion (answer g).

Table 5.4 - Number of responses for six options regarding participants’ general view on maps, where the respondent chose a single answer only.

Not one respondent chose answer f, ‘I don’t think that maps are that useful; brochures or information sheets are much more useful’, or the eighth possible answer ‘Other’. The remaining 26 people ticked multiple answers, with the above top two answers a and e also the most popular in combination, followed by answers a and d in combination. Overall, the two most popular answers were answer a (48) and answer e (31).

It appears that although maps are generally regarded as useful, a significant number of people would like to use them in combination with other information rather than a standalone map. Provided the design was right and appropriate to user needs, the conceptual participatory Web tool described in question 15 could be useful if it let people choose their own information and put it together as a map or other document as appropriate to take along on their trip. As aforementioned, the potential use of this tool is already quite high, around 70% for people aged 18-60.

5.5.2.4 Responses to ‘About your stay at Wilsons Promontory’ open questions

The final set of questions was partly related to the participants’ current trip to WPNP and gave participants the opportunity to provide extra feedback or comments. Some of this information could be useful for the development of the conceptual GKT, as it gave some insight into people’s interests that in turn gave an idea of potentially valuable information people may not just be interested in receiving but may actually possess.
themselves to share with others. Most of the comments and feedback however would be more pertinent for Parks Victoria or WPNP to take into consideration.

The first of these open questions asked what main activity or activities they had undertaken during their stay. The 81 responses generally included multiple activities and, being open questions, resulted in a wide range of answers. Table 5.5 shows the answers in order of popularity, including variations deemed to be similar or falling in a similar category (for example: swimming, paddling and surfing are all considered to be water based activities).

<table>
<thead>
<tr>
<th># of responses</th>
<th>Activity undertaken</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Walking; this includes short walks, day walks, walks, walking trails etc.</td>
</tr>
<tr>
<td>32</td>
<td>Hiking; this includes bushwalking, overnight hike, and 4 day bushwalk</td>
</tr>
<tr>
<td>18</td>
<td>Camping</td>
</tr>
<tr>
<td>11</td>
<td>Sightseeing</td>
</tr>
<tr>
<td>10</td>
<td>Beach</td>
</tr>
<tr>
<td>9</td>
<td>Wildlife / bird</td>
</tr>
<tr>
<td>8</td>
<td>Swimming / paddle / surfing</td>
</tr>
<tr>
<td>7</td>
<td>Photography</td>
</tr>
<tr>
<td>5</td>
<td>Flora</td>
</tr>
<tr>
<td>5</td>
<td>Relaxing / resting / lounging</td>
</tr>
<tr>
<td>4</td>
<td>Eating / lunch</td>
</tr>
<tr>
<td>3</td>
<td>Day visit</td>
</tr>
<tr>
<td>3</td>
<td>Fishing</td>
</tr>
<tr>
<td>1</td>
<td>Running</td>
</tr>
</tbody>
</table>

Table 5.5 - Various activities undertaken by respondents during their trip, and the number of respondents that undertook these.

The ensuing question as to how they enjoyed the activities only elicited positive responses. The 61 answers included comments like "loved it", "fabulous", "beautiful", "have been here in the past" and many more.
To the question whether they wished they had additional information during their stay, 46 out of 74 respondents said ‘no’, whereas 29 indicated that they had wanted additional information and subsequently listed what that was. The free format comments are difficult to summarise, but, very broadly, include a need for more detailed maps, and more information about natural and cultural features as well as visitor services and park conditions. Following is a selection of additional information that was regarded as missing according to survey respondents.

- “Better access to info about flora/birds to assist with identification”;
- “Better sense of info getting from Melbourne (signs)”;
- “Better signposts for walkers – kept getting lost at Tidal River”;
- “Geological information / cultural information”;
- “Historical notes, e.g. who was Norman!” [Author’s note: this is a reference to Norman Beach, the main beach at Tidal River];
- “More detailed park map and hiking map right at the entrance”;
- “More fishing information (places to fish – type of bait required etc.)”;
- “The history of the park, and how it is recovering from the bushfire”; and
- “We left our native orchid book at home”.

The final question simply asked for any other suggestions or comments, to which 20 people responded. Instead of giving general feedback, some respondents linked their comments to the research and survey they had just completed. Again, as these remarks are free format they are somewhat difficult to sum up and categorise. Listed below therefore are firstly the apparent survey related comments, followed by examples of other feedback provided by the participants.

- “I think the personalised maps and brochures is a great idea! Also people sharing favourite spots on trails and their idea of its difficulty and why”;
- “Many of us are interested in such technology, and would use it but may not have the time to be the actual participants giving the information”;
- “More technology to help people plan trips to the Prom is a good thing”;
- “Walking trails maps available on mobile would be good (via Web/downloadable) e.g. as applications”;
- “An information/natural history exhibition/centre with detailed info where visitors can choose the info and talk to others is VERY good value”;
- “Could be useful to have self-booking software, showing vacancies and allowing clients to reserve/choose, securing bookings via credit card on-line”;
- “Do not develop the Prom any further - with resorts etc. It is beautiful in its "primitiveness". It is my favourite place on Earth!!”;
- “I find it very nice that the park entrance was free. Very nice facilities at the campground :); and
- “I grew up in this area as a child, this is the first time back in 35 years. You can see the pressure of people & the need to improve facilities”.

5.5.3 Evaluation of park visitor survey results

One of the key outcomes of the survey was to gain insight into the perceived willingness of park visitors to participate and contribute information. This could be through a hypothetical crowdsourcing project organised by managers at WPNP or through collaborative Web based tools that the organisation would employ. Three questions, 9, 10 and 13, asked this more or less directly. Other questions were aimed at determining people’s usage and views of aspects of Web 2.0, in turn assisting in learning whether they would be more or less likely to participate and what kind of information they could potentially contribute using which tools.

The primary focus of the analysis is on questions relating to Web 2.0. It thus commences with questions 9, 10 and 13 before other Web 2.0 related questions are included, and concludes with observed variations in age and gender.

5.5.3.1 Key participation questions 9, 10 and 13

Considering the responses to questions 9, 10 and 13, participation in a crowdsourcing project or using collaborative tools by park visitors may depend on whether the activity is a one off, and whether it has a specific task. Questions 9 and 13 ask that people upload photographs after their trip or carry a GPS device during their trip – more or less one off events with a specific task to undertake. In both cases, around 65% of people responded they would probably participate. Question 10 however is more general in nature – would they use Web based communication tools if WPNP provided these - without stating a specific purpose, why or what needs to be done. This time only 42% said ‘yes’, with a further 22% saying ‘perhaps’ pending more information. Figure 5.18 shows the number of people who responded ‘yes’, ‘no’ and ‘perhaps’ to questions 9, 10 and 13.
Figure 5.18 - The number of ‘yes’, ‘no’ and ‘maybe’ responses for the three questions that
directly asked if people would participate (questions 10, 11 and 13).

Question 13 arguably stated the task and purpose most clearly: carry a GPS device
around during your trip to assist park research. With the exception of two, all
participants indicated either ‘yes’ or ‘no’. The photo-sharing question 9 had 10
respondents demanding more information before they could commit, as the purpose of
the task was arguably less clear than that of question 13 (share photos with park visitors
versus assist park research). Question 10 was more general again (would they use tools).
The 18 ‘maybes’ could become potential participants once the task or purpose is clearer.
This is perhaps backed up by the fact that the majority of participants indicated they
would use the tools only around a trip to WPNP – the results of question 11 associated
with question 10. Half of the people that would use the tools from question 10 and well
as 75% of the people that may use them pending more information would most likely do
so after a particular trip to the park. So, if question 10 was asked in a less general
fashion, and instead included information along the lines of “could you please visit our
website and add feedback or observations from your trip to our blog or feedback forum
after you return home to help us with…”, people may actually be more likely to do so.
A more direct, more purposeful request may further change the number of users versus
contributors. The results of question 10 indicated that people were less likely to
contribute information themselves, and instead would use tools to merely read or look at
other people’s contributions. If question 10 was turned into a more purposeful, task
specific exercise, these non-contributors may change into actual participants and
contributors of information now that they are being asked for specific information and
know the purpose and task required.
The trigger therefore appears to be the need to have a purpose - whether this is a trip to the park or a specific task. Not only do people need to be attracted to participate while they are visiting a park, they also appear to be more willing to participate if asked to complete a specific task for a specific purpose. Attracting people during their visit – other than asking them to participate during that particular stay – could involve signing visitors up to an email list so detailed information can be sent out when visitor participation is sought. This is because it seems that the vast majority may not visit Parks Victoria’s website or use social media tools unless they are about to undertake a visit to a park.

This should not matter as such, as it would supposedly be the time when visitors possess potential valuable information from their trip such as animals or flora they may have spotted, feedback on the condition of walking tracks or any other visitor experiences. Although the result to question 11, that most people would not participate often and would only use Web based tools before or after a trip to WPNP, may not inspire optimism, at least they would be participating when going to the park and confirms the importance to attract people’s participation during their stay.

An issue arising from question 9 is that the problem with asking people to upload images from their trip onto a photo-sharing site - whether a dedicated site or not - could be that people may be inclined to upload only a few good pictures rather than all their photos. Although this can still assist other park visitors or give a general idea about people’s activities and where they go, it may reduce the opportunity to get more in-depth insight into park visitor behaviour simply because the available data is not vast and varied enough. It would therefore seem prudent to not restrict people in their participation in any means including from a technical storage space or capacity, and instead encourage the uploading of many pictures, adding multiple tags, and providing feedback on many topics.

5.5.3.2 Adding other Web 2.0 related questions

Less than half of the participants use the Internet on mobile devices, based on the results for question 4. However, communicating using mobile devices would seem a useful way to exchange information and knowledge between park staff and visitors during the latter’s stay. Additionally, the Twitter application that uses messages of maximum 140 characters to communicate is regarded as a potentially useful mobile application for
communication between and amongst park staff and visitors, but had a low number of users amongst the park visitors (question 3). There are a few things that could be taken into consideration here. Firstly, question 4 did not ask if people had a mobile device as such and considering the high volume of mobile phones in Australia, it is highly likely that the vast majority of people would possess and carry a mobile device during their trip – GPS enabled or not. Secondly, Twitter is accessible through SMS technology as well as the Internet, and the latter would therefore not be necessary for people to use. However, if free Wi-Fi enabled Internet access was available at WPNP, specifically to enable people to communicate in this way, visitors may well use the Internet on their mobile device (provided the device had Internet access capabilities of course). Lastly, although Twitter was not popular with visitors according to the survey, recent social media statistics suggest that Twitter has grown to be the second most used application on a mobile device after Facebook (Susan 2011). Facebook was already popular with visitors, but if people became aware of a Twitter application to instantly communicate with park rangers or keep up to date with activities while visiting the park, about 65% of people could potentially use the tool.

The results of question 8, if people would only upload safe information, showed that almost two thirds of people at least agreed that they would, and only contribute information that they did not mind being passed on or used by others. When comparing the results of question 8 with the potential photo-sharing participants of question 9, of the 51 people that would potentially upload photographs, 41 agreed or strongly agreed that they would only upload safe information. Similarly, comparing the results of question 7 with question 9, of the 21 people who answered that they do not think the Web is dangerous, 20 would potentially upload photographs. This suggests that people are generally aware that information on the Web is there for everyone to see and use, but how these two results affect the theory behind the GKT is unsure. Would half the people not participate because they deem it unsafe, or would they know to just upload safe information and therefore be inclined to participate? In addition, the fact that they would only upload safe information, does that hinder the ability to analyse it and find potentially useful information, simply because not everything is uploaded, just selected items?
5.5.3.3 Variations in age and gender

Some differences between participants of different age groups as well as a slight gender variation could be observed. The results of question 3 of the general question showed that people in the age group 61+ were the least aware of Web 2.0, with only 50% of the participants in this age group knowing about it. Ten of the 18 respondents in this age group still had positive ideas about the concept of participation and collaboration however, choosing ‘Interesting’, ‘Fun’, and ‘Useful’ as part of their answer in the later question 6. Another four had neutral answers. Four people aged over 60 who were not aware of Web 2.0 also had positive or neutral views, with only one having a clear negative answer (a combination of ‘Exaggerated’, ‘Waste of time’, ‘Latest trend’, and ‘For younger generation’). In view of this, although they may not be as aware of the phenomenon as people in younger age groups, this does not mean that people over 60 are necessarily not willing to participate and contribute. Although the results of question 9 and 10 show that people in this age category are the least likely to participate, for question 9 (sharing photos) this is still 50%. Their potential participation rate for carrying a GPS around is even higher with 67%, being topped by only the 18-30 year olds. People in the oldest age group may therefore conform to the general trend observed, and are more willing to participate the clearer defined the purpose and task is, as their participation rate for questions 13, 9 and 10 is 67%, 50% and 22% respectively.

The youngest age group, people aged 18-30, was overall the most willing to participate with 80% potentially willing to upload photos and using Web 2.0 tools provided by park management, whilst all would potentially carry a GPS device. What is perhaps somewhat interesting is that it is the people aged 46-60 who are the second most likely participants, beating the 31-45 year olds for questions 9, 10 and 13 (refer to total columns in figures 5.14, 5.15, and 5.17). The females in this age group in particular where more willing to participate than females in the 31-45 and 61+ age groups. In question 10, they even outnumbered their male counterparts when it came to using park management provided Web 2.0 tools (unfortunately, despite their high potential to use the tools, they would not contribute any information themselves). Having a higher number of female participants was rare as overall males were more inclined to participate then females. This was the case for three of the four age categories with the exception of the 18-30 age group. For this youngest group of people it was equal twice and a higher percentage of female participation for question 9 (sharing photos). The male participants in the age groups 31-45 and 61+ in all three instances (questions 9, 10
and 13) were more willing to participate than their female counterparts. They were also more likely to use the Web based mapping tool introduced in question 15 (70% of all males versus 59% of all females).

Other differences that were observed between different age groups and gender were described earlier in the results of question 3. These were the number of social media tools used per person and the actual applications used.

5.5.4 Discussion on visitor survey results

The outcome of the survey suggested that people are potentially more willing to participate and contribute information if there is a specific task or purpose involved - around two thirds of people may in effect do so. This would mean that if managers at Parks Victoria or WPNP require certain information and park visitors (or the general public with an interest in park related matters) can assist in collecting or contributing this information, a special crowdsourcing project could potentially be successful. This project should be task and purpose specific so its participants know what they are required to do and why they are doing it. Such a crowdsourcing project could be conducted at WPNP, requiring people’s participation during their stay with all relevant (technical) equipment supplied but, pending the type of information sought, it could also be organised as a Web based project that allows people to participate and contribute from home. Because of observable differences between people from different age groups and gender with regards to their potential willingness to participate, it is possible that a crowdsourcing project at a park is more likely to attract a broader range of participants than a Web based project.

In order to attract the broadest range of participants possible, the variations observed in age and gender should be taken into account when considering which Web 2.0 applications to utilise for crowdsourcing opportunities. Picking tools that people already use would allow them to link with the project through their personal Social Web activities. A variety of options would have to be available to appeal to different age groups. It may also require targeting or marketing certain age groups or gender more specifically in order to ensure they are less likely to be underrepresented as participants. Apart from the project or activity requiring a clear focus and set task, there should also be assistance available for those requiring further information. This would be to minimise the number of people who are not participating because they are unclear about
objectives or what tasks they are required to complete (the people with ‘maybe’ answers that covered all age groups and genders).

The idea behind crowdsourcing is that bits of information contributed by individuals combined create a big picture or contribute to solving or completing a bigger project. Although there is a higher chance of people participating if asked to complete a specific task or contribute specific information, there is also potentially valuable information that is not specifically requested. To try and capture this passive information people contribute, it would be useful to have a dedicated Parks Victoria (or WPNP) website that allows people to upload specific information in what can be regarded as a safe environment to minimise any reservations people may have about participating, as well as having a presence on the wider Web. This latter could be for example a presence on social media sharing applications like *YouTube, Facebook or Flickr*\(^8\) that do not ask for specific information, but merely encourage people to share any information they wish (albeit restricted to the media format permitted on those sites). A combination of both specific information requests and the opportunity to capture any information could potentially enhance or complement Parks Victoria's existing data archive and thus assist decision-making. Although the former arguably has a higher potential to improve known information gaps, particularly from a practical perspective, the latter may also unearth additional information that some people possess but that could be more difficult to ask for specifically, because it is rare or too precise or perhaps because it was previously unknown.

### 5.6 Conceptual model of a geo-knowledge tool

The first component of the theoretical methodology for a GKT – the primary outcome of the research project – was a conceptual model of the GKT. The development of this conceptual model was based on findings from the case study related activities described in the previous sections and those from chapters 2, 3 and 4. Its purpose was to outline the different elements that could form part of such a tool or might need to be considered. The conceptual model or conceptual GKT is thus a theoretical solution that pulls together findings from the various investigative activities and initial information

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\(^8\) It must be noted that since the visitor survey was conducted and analysis of the results completed, Parks Victoria has done exactly that. Described earlier in Chapter 4.5, the organisation joined four key Web 2.0 applications in the first half of 2011 - *Facebook, Twitter, Flickr* and *YouTube*, whilst its website was updated to a more Web 2.0 oriented site that allows the general public to contribute information.
gathering phase to create a visualisation of what a GKT should contain or consider. It does not address nor propose any technical issues or solutions, these being outside the scope of the research project as described in the Introduction chapter.

The final form of the conceptual GKT comprises two mind maps. These mind maps commenced as the drawing of ideas using paper and pencils, which progressed into the use of mind mapping software once sufficiently developed. The software applied was Xmind – an OS mind mapping application that has a free version with basic capabilities\textsuperscript{89} that was deemed sufficient for the research's intent. After completing draft versions of the two mind maps representing the conceptual model, three Parks Victoria staff members connected to the research project – one associated with WPNP and two from the organisation’s Head Office – were asked to provide feedback and particularly check that Parks Victoria related information representing current situations was accurate. The two maps were subsequently modified bearing in mind this feedback. Figure 5.19 and Figure 5.20 represent the finalised versions of the conceptual GKT. Figure 5.19 considers Parks Victoria as a whole with an emphasis on fire management in general, whereas Figure 5.20 has shifted focus to WPNP and includes details of ecological planned burns. Both figures merely aim to show the visual organisation of the mind maps here. Due to the capabilities of the XMind software, the resulting images are large and the details are generally illegible when presented as A4 size. Appendices VIII and IX therefore show A3 size versions of the two conceptual models, whilst portions of the broad mind map are shown in the next sections that discuss various elements in more detail.

5.6.1 Components of the conceptual model

The conceptual model has four main components – 'data in', 'users', 'functionality' and 'data out' – with the broad mind map (Figure 5.19) branching out from these four parts. Because the second mind map (Figure 5.20) is more detailed, the 'functionality and 'data out' component were combined to allow room for the expanded 'data in' component that was split itself into existing data (traditional) and alternative data. Both mind maps therefore cover the same elements, but their overall layout is slightly different. The different colours and shades thereof on the maps represent different parts – green shades

\textsuperscript{89} Refer www.xmind.net for details. A more advanced version with additional capabilities can be purchased.
Figure 5.19 - Conceptual model of the GKT in broad terms, based on Parks Victoria and fire management in general.
Figure 5.20 - Conceptual model of the GKT focussing in more detail on WPNP and ecological planned burns.
for example are representative of items related specifically to Parks Victoria, blue shades represent non-Parks Victoria users whereas purple and pink shaded items relate to the Web and social media. The mind maps identify relevant linkages between various components and their subcomponents using line symbols. The grey and white boxes on the maps, also containing either a star or exclamation mark symbol, represent ideas or issues for consideration. The following sections explain the content of the four main components of the broad mind map, the key linkages and issues identified in more detail.

5.6.1.1 Data in

The 'data in' component shows the variety of data sources within the traditional and non-traditional realms that the GKT can draw on. The traditional data section (see Figure 5.21) forms the base data for the GKT and includes corporate data, legislation and expert data from traditional partners and stakeholders such as DSE.

![Figure 5.21 - Portion of broad conceptual GKT depicting traditional 'data in' section.](image)

Local data are also listed under the traditional data section because they originate from within Parks Victoria. Although local data have not traditionally been accessible to all
staff, within the objective of providing access to the existing park management data lays the goal of making all relevant Parks Victoria data accessible to all staff. Existing organisational information systems are themselves also part of the traditional data sources. Considering non-digital data, these are generally not accessible or utilised because people need to know that the data exist and what they comprise. These data would preferably be digitised for the purpose of the GKT. However, non-digital data that can not easily (or economically) be digitised would require digital records as a minimum, with relevant metadata so that the data become findable and thus accessible.

The non-traditional data section (see Figure 5.22) considers existing digital data repositories and new data obtainable through participatory tools and projects. Examples of existing digital data repositories, described earlier in section 5.4, include websites of media organisations, libraries, museums, journal collections, organisations in the park management or natural environment realm, and social media applications.

New data can be generated by staff or non-staff with varying levels of expertise using social media tools and through crowdsourcing projects that are Web based or on mobile devices. These tools can elicit any user contributed data or a crowdsourcing project organised by Parks Victoria or managers at WPNP that asks participants for specific data. As the results from the visitor survey showed, described in the previous section 5.5.2, 65% of parks visitors could potentially participate and contribute to a collaborative project provided it was organised appropriately with a clear purpose and defined tasks to be completed.

The generation of new data links to the ‘functionality’ component, as the data can be created using the participatory tools that form part of the GKT. New data can also be generated through conventional methods like staff research, fieldwork and so on.

An issue noted at this point is the need to rate non-traditional data, both existing and new, to assess their quality and usefulness. Possible data attributes for rating the data noted include the data’s source, quality, relevance, usefulness, and the level of Parks Victoria (PV) control involved in the creation of data (through organised crowdsourcing projects for example). The need to rate data can also depend on the expertise of users who generate the data (linked to ‘users’ component). A theoretical methodology for a confidence rating system to address this issue is described later in section 5.6.3.
5.6.1.2 Users

The second component, 'users', identifies the range of potential users of the GKT, divided into Parks Victoria staff and non-staff and their particular expertise (see Figure 5.23).

Different Parks Victoria staff may have different data requirements, and categorisation of staff would assist with appropriate and efficient data access. Examples of divisions include divisions by role (for example management, office staff and field staff); by location (for example head office, regional office or a park), and by position, department or management divisions. Apart from Parks Victoria staff, employees of partner agencies and other stakeholders could become users of the GKT to access and potentially contribute data. Additionally, park visitors and the public at large, with or
Without a vested interest in parks or the natural environment, could become users and contributors. A user login system would need to be applied so data access can be restricted and made appropriate to different user types.

Different users have varying levels and types of park management related expertise that is arguably reflected in the quality and usefulness of their contributions. The data contributed by these users can be rated accordingly. The four levels of expertise described are:

1) Park management experts such as Parks Victoria staff and partners;
2) Other expertise potentially useful to Parks Victoria like experts in GIS, mapping, sustainable building, knowledge management or beekeeping that can be found in partners, stakeholders or the general public;
3) ‘Amateur’ experts whose knowledge is gained through ‘unofficial’ means like an interest or hobby rather than a university degree or professional work experience; and
4) Non-experts that could comprise stakeholders and the general public including park visitors without any ‘official’ or ‘unofficial’ expertise or knowledge.
5.6.1.3 Functionality

'Functionality' is the third component (see Figure 5.24) and considers the tools available to users and how they can interact with the data. User tools include personal ones like tagging data, creating personalised maps, subscribing to RSS feeds of choice, and saving data in a personal location.

Overlapping with personal tools are collaborative tools, such as participating in blogs, providing feedback, using wikis or sharing photos and videos. These user tools could be accessed via the Web, and can be either Parks Victoria specific sites like the organisation’s website, Facebook, YouTube, Flickr or Twitter pages, or they can be external sites. New data being generated by users as a result of user tools links back to the ‘data in’ component.

Functionality is also about data interaction and what users can do with data. Data interaction can involve analysis, searching, saving and storing of data, annotating or adding keywords, and creating maps and graphs. Search methods can be based on text or by using a map. Data would thus need to be tagged with keywords based on the
classification of data and users being applied. Searching for data using maps would require the use of appropriate mapping tools as well as geographic attributes representative of the geographic information attached to the data, and links to the 'data out' section. Attaching tags and geotags to data can be informal and defined by users, or formal, following formally recognised structures and divisions in place at Parks Victoria or elsewhere.

An issue noted in this component (not depicted in Figure 5.24) is the variation that exists in the georeferencing of digital data, and which would have to be addressed in order for all data relevant to a particular search to be presented. Section 5.6.4 proposes a theoretical methodology for addressing this issue.

5.6.1.4 Data out

'Data out', the fourth and final component (see Figure 5.25), outlines a number of elements and is about the output of the tool, when users search for data to access or interact with.

Figure 5.25 - Portion of focussed conceptual GKT depicting the 'data out' component.
An important element is the actual access requiring a user interface. Data’s inherent geographic attributes can be used to access data. These include Parks Victoria as an organisation or network and subdivisions like regions, one or more parks or an area or location in a park. A geographic attribute can also be beyond or bigger than Parks Victoria such as another Australian state, Australia or an international location. Access is directly linked to the ‘functionality’ component and considers text and maps, and use of formal and informal tags and geotags to find and present data. Data that are related need to be linked to assist users in finding other relevant information. The appropriate tagging of data can assist here.

The data need to be organised and categorised so that relevant keywords can be attached to search, present and map the data. Classifying data would follow both existing conventional categories used by Parks Victoria as well as user contributed keywords. Apart from a geographic attribute, Parks Victoria defined categories can include the purpose of the data (for example policy, background or research), the data type (for example a report, map or image), existing management divisions and departments or topics (for example history, geography, hydrology, flora or ecology). The mind map identifies the focus area of the case study area as fire management and planned burns. Natural values management includes ecological fire management, and fire and emergency management includes public land management.

Data visualisation is linked to data access. It uses data attributes that in turn would link relevant data to access and visualise the data in different ways according to user needs. Users may gain knowledge if the data presented to them is useful and relevant to their needs, and visualised appropriately.

Portions of the conceptual model were selected to develop a demonstration prototype to assess the theories applied. The ‘data in’ component was regarded as the most important for the purpose of the research project and subsequently the demonstration prototype. This was because the research’s main objectives were to provide access to traditional and non-traditional data, and assess if access to the latter could benefit the former. Ultimately, how that access is provided, what personal tools users can utilise and the various ways the data can be organised for instance were considered less important when it came to these objectives. They are therefore part of the conceptual model as elements of the ‘functionality’, ‘users’ and ‘data out’ components, but were not key
considerations for or working elements of the demonstration prototype. Access to a range of traditional and non-traditional data on the other hand would arguably provide reviewers the opportunity to form an opinion on the potential usefulness of having access to both types of data sources. Nonetheless, section 5.7 describes the overall design process including the design of the user interface in detail.

5.6.2 Considerations

The conceptual model listed a number of other issues associated with Web 2.0 that were encountered during the research, most of which need to be considered as a minimum should an actual GKT be built. A number of these issues were previously discussed in Chapter 2.5 but are iterated here. The issues listed on the conceptual model are the privacy of users and data contributors, and the issue of data copyright and ownership – for example, how can UCI be used by others such as Parks Victoria staff or other system users? As aforementioned, at time of writing, Parks Victoria has joined Facebook, Twitter, Flickr and YouTube and its participatory website now allows users of the site to contribute information. The website’s Terms of Use and Privacy sections subsequently now cover these exact issues and stipulate the use of licences (to deal with copyright and re-use of UCI), Parks Victoria’s rights on how to use information contributed by people to the site, and its use of personal information. Should a GKT be built, no doubt the organisation would address these issues in relation to the GKT in a similar manner.

Other issues listed on the conceptual model are the issue of equity and accessibility concerning user access and utilisation of the GKT; compatibility with other Parks Victoria systems and procedures; and maintenance of the system to keep a GKT accurate and current – although undoubtedly more issues could be considered. Regarding accessibility and equity, this relates to the Participation Divide and Digital Divide described earlier in Chapter 2.2.2. General Web design guidelines, and legislation and guidelines put forward by the Victorian Government concerning accessibility and equity could at least partly assist in addressing this. Doing so ensures that any potential users of the GKT are not hindered in any way in their interactions with the tool, and can participate and collaborate equally. Considering the use of OS software for developing an actual GKT may also reduce the effect of this issue, as it would mean that no specialised software would be required for users to participate.
This links with the next issue listed of compatibility with other Parks Victoria systems. This is in part about fitting in with existing systems, and ensuring that there is no duplication of internal systems or tools. For example, Parks Victoria’s ParkView system already provides map based access to data. Instead of developing a separate new tool using new software, could the proposed GKT and ParkView be integrated and somehow function together rather than be used as two stand-alone systems? The same applies to linking the collaborative tools in place on Parks Victoria’s website or the organisation’s internal SharePoint software with the user tools proposed on the conceptual GKT.

The last issue noted, system maintenance, would be a consideration when developing any new tool or system such as the GKT. Policies or guidelines would be required to ensure the system is maintained appropriately and different aspects checked, updated or amended as required. One or more staff could be appointed with specific duties to work on maintaining the system and the data. However it is achieved, the most important consideration would seem to be to ensure that the data the GKT provides access to are relevant, current and accurate so that it becomes an effective tool for finding data.

As aforementioned, the research project addressed two more issues outlined in the ‘data in’ and ‘functionality’ components. Proposed solutions are theoretical methodologies for a basic geographic framework and a confidence rating system. These are described in sections 5.6.3 and 5.6.4.

If a GKT were to be built, all issues listed above would need to be considered at least, and dealt with as appropriate with policies and guidelines developed. It was outside the scope of the research project to fully address these issues and device solutions. From the research perspective, and for the purpose of the demonstration prototype that was developed, it was presumed that these issues would be addressed by Parks Victoria or WPNP. For example, it is presumed that the privacy of user contributions is protected, that due care is taken in doing so, and that the liability is taken from the contributions and that Parks Victoria instead is responsible for the accuracy or quality of data – or else provides a statement as to the appropriate uses and reliability of data.

Finally, listed on the conceptual model in the ‘data in’ section but not specifically identified as an issue to be considered, the research project also presumed that in order for an actual GKT to be developed and the theories outlined in this paper to work, Parks Victoria would digitise all its non-digital data or create digital records where applicable.

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This digitisation of data includes all local data not generally used or accessible to everyone. Perhaps the TRIM system could be expanded to also keep electronic records of non-official data. The organisation may need to develop a stocktake method for staff to digitise their data and provide such files and records, or else organise a special project to ensure that even boxes with research reports from the 1970s currently kept at a regional DSE office are included in the digitising project. This could mean that the stocktake of local data and non-official data may have to be broadened to also include DSE data identified as belonging to Parks Victoria’s predecessors. This digitising would need to include scanning its content and attaching keywords that describe the data as concisely as possible including geographic attributes so that they are found and presented when relevant.

5.6.3 The issue of data quality and usefulness of alternative data sources

A key issue identified early in this research and described in Chapter 2.5 is the quality, or lack thereof, of at least some of the information generated by users of Web 2.0 tools – UCI. Because the research project considered a broad range of alternative data including UCI, the issue of data quality applied to all non-traditional data sources the GKT could draw on including existing digital data repositories on the Web. It was argued that users of a potential GKT would need at least a sense as to the quality of the data they find.

5.6.3.1 Existing rating systems

Addressing the quality issue is not new. Projects like Wikipedia and OSM have standards in place to ensure the quality of the data contributed by their users is sufficiently accurate for the systems to work, whilst many participatory sites have adopted rating or ranking systems using algorithms or users. These rating mechanisms often focus on ‘reputation’ of the contributor or a site rather than the quality of data itself. However, the reputation ratings more or less provide an indication as to the potential quality of the contributions or the data found on these sites. On eBay and Amazon for instance, users can rate the sellers and buyers they buy items from or sell to, based on their personal experience with the transaction. On eBay, buyers can rate the accuracy of the item’s description, the satisfaction with the communication and postage and handling charges. These ratings help future buyers in deciding if they would buy from a particular seller or choose another one with a higher rating instead.
Another example is Slashdot\textsuperscript{90}, a website that aggregates technology related news stories that readers can also comment on. Moderators apply a rating system to the comments, which in turn rates the contributors of those comments based on whether they were “…intelligent, funny, informative or…generally impressive to fellow readers” (Slashdot 2012, para. What is Karma?). Slashdot also uses the rating system to improve the level of moderators, who are users themselves (Slashdot 2012), thus ultimately working towards a high quality, relevant debate.

Instead of asking users to rate contributors, ranking algorithms are also applied. The site Klout\textsuperscript{91}, for instance, measures the influence of contributors whereas the social media search website Technorati\textsuperscript{92} measures the reputability of sites using its ‘Technorati Authority’ and ‘Technorati Rank’ algorithms. Google\textsuperscript{93} indirectly rates its search results by the order they appear in through a ranking algorithm in its search engine. According to Singhal and Cutts (2011, para. 2), low-quality sites “low-value add for users, copy content from other websites or [are] sites that are just not very useful… [whilst] high-quality sites [contain] original content and information such as research, in-depth reports, thoughtful analysis and so on”. Search results are more or less organised by popularity and the number of links to sites. Users can therefore increase a site’s ranking by linking to it through their own site or blog if they regard it as useful.

Although aspects of these rating systems are potentially useful for a GKT, it is argued that they do not provide a solution to the issue of data quality as it applied to the research project. This is primarily because the conceptual GKT functions differently from the sites described. It was outside the research’s scope and technical capability to develop a technical solution or ranking algorithm. Instead, a theoretical methodology was proposed that uses confidence ratings to help users assess the potential quality and usefulness of alternative data sources. When applied in practice, this would make a GKT more effective and assist users when considering whether to use the accessible data in their decision-making.

5.6.3.2 A theoretical methodology for deriving confidence ratings

Assessing quality or accuracy and usefulness is not straight forward, and arguably a difficult task. What is this based on? Who decides whether information is quality
information or not? Although some data can clearly be accurate or inaccurate, there are also different levels of accuracy, each of which may be acceptable for different purposes. Assessing usefulness is in part dependent on the user. What is the user’s purpose or what are their intentions with the data? Resources – time, money and manpower – could of course be used to analyse the data and thus determine which are acceptable and which are not. High and low quality data could be filtered out in such a way, but for the data in-between, the data of medium quality perhaps, the distinction is not so clear as they could be useful for some purposes but not for others.

Because quality and usefulness are not straightforward to assess, the research project proposed that an appropriate technique was to provide indicators instead. These would show what quality can be expected or what the likely usefulness of the data would be. These indicators would not be absolute per se and their relevance can vary depending on how the data are used. Data quality may appear to be a more dominant issue, usefulness was equally considered in part because the two are linked. Furthermore, quality within the realm of this methodology is related to characteristics such as accuracy and credibility. The initial term ‘quality indicators’ was therefore regarded to be too narrow, and the research project developed a theoretical methodology for a scale of confidence or ‘confidence ratings’ instead, in an attempt to encompass the multiple considerations.

An element of the conceptual GKT is the classification of data – according to both existing conventional categories used by Parks Victoria and user contributed keywords – to enable data access using these data attributes. Certain data attributes may not only help assess the usefulness of that data, some may also affect or influence whether the data are regarded as accurate and trustworthy or not. Most of the data attributes used for deriving the confidence ratings methodology were identified during the investigation into existing digital data repositories and Parks Victoria’s data deemed relevant to the case study, described earlier in this chapter. One thing to bear in mind is that the idea of ‘confidence’ can evoke multiple concerns, such as confidence in the quality of the data, confidence in relevance to the topic and confidence in the accuracy of the geographic location. For the purpose of the confidence rating system, confidence was considered as a broad concept, however, the system would allow for personal annotations to be attached to data to describe specific concerns.
5.6.3.3 Data attributes

The initial three attributes that can assist in assessing the potential quality and usefulness of existing data are 1) the data source, 2) the data contributor and 3) the level of control from Parks Victoria in the data generation. To explain:

1. The data source - This is arguably the key indicator for a quality assessment; where do the data come from? Can the source be regarded as reputable or not? Are providers experts in their field? Are they a professional organisation or is it a personal blog? Is the source likely to be biased? And if there is a potential for bias, can the data still be regarded as reputable because the provider is a professional or supports their view, or is it just someone’s personal opinion without any such credentials? Examples of potentially relevant data sources with seemingly varying quality or usefulness ratings are the IUCN, Melbourne’s newspaper The Age, the VNPA, a personal bushwalking blog, and an apparent standalone blog on the history of WPNP with hyperlinks to VNPA and the Friends of the Prom community volunteer organisation.

2. The data contributor – Although related to the data source, the difference is perhaps best explained by considering websites that gives access to data contributed by different people. For example, the ABC website on one hand comprises news articles written by professional journalists as well as opinion pieces - some written by authors with clear agendas that are linked to or supported by certain organisations and whose credentials arguably vary. Additionally, there are reader comments, written by the general public. They are arguably the non-experts who can add comments to existing stories, although, like the opinion writers, some of them can contribute valid and accurate points and may have hidden credentials (or none at all). On the other hand, if we take the archives of the State Library of Victoria and the National Library of Australia, these in essence give access to data from others and it is perhaps the origin of these original data creators that should be considered rather than the reputable State Library of Victoria itself who is more of an access enabler here. The data contributor, like the data source, can refer to organisations, groups or individuals and their expertise or reputation, ranging from expert and professional to the non-expert general public.

3. Level of control from Parks Victoria involved in data generation - This refers to UCI that is specifically asked for versus any UCI or data found on the Web. For example, if managers at WPNP involved volunteers to monitor specific wildlife (as seen in a special project between the Conservation Volunteers organisation and
For instance, there is a high likelihood that they will obtain useful data at a desired quality. This is because there is a high level of control involved that asks the participants for specific details, visit specific areas, look for specific species, and record specific observations. Alternatively, encouraging park visitors to contribute to Parks Victoria’s website using participatory tools without detailed instructions may result in UCI having varying levels of both quality and usefulness. Furthermore, data analysis will most likely be required to ascertain the UCI’s potential level of quality and usefulness.

Additional attributes that were identified as having the potential to assist with assessing data quality and usefulness are:

4. Data access - Are the data available in their full extent online, or are they merely digital records providing limited information only? Would accessing actual documents require lodging a request and going to a particular repository or location? It may be necessary to register in order to see complete documents and if so, is this free and relatively simple or is a paid subscription required?;

5. Search options - How good are the search facilities of the source? Does a site give advanced or detailed search options? Does a site give relevant results or is it a matter of sifting through many search results?;

6. Level of detail - Are the data generalised and on a broad scale or do they provide precise details? This partly relates to the data source, as detailed data from an expert source could be regarded as useful and accurate, whereas detailed data that are more likely to be biased would be less so;

7. Data purpose – Are the data factual or are they opinion? Do the data provide background information or are they base data that are meant to be combined to form new information?;

8. Year of data creation - How old are the data? If data were created some time ago, are they still accurate or have they been superseded by newer versions? Do they provide a historic perspective or are they not relevant anymore?

5.6.3.4 Classifying data attributes

Considering the primary indicator, the data source, deciding which data providers are reputable or biased is arguably a subjective issue in itself. An organisation such as Parks Victoria would have views about what sources are considered reputable or credible and which are not. Usefulness is similarly a subjective matter. Apart from the purpose for
using the data, user attributes like available time and resources can make the difference between some users being able to visit a library or searching through many results whereas others may not. Hence the attributes listed in the previous section will be viewed differently by those users.

One way to deal with this subjectivity is to apply general guidelines or indicators. This can be achieved by classifying and subsequently ranking the data attributes. Data sources, for example, can be classified using seemingly inherent terms like media organisations, government and natural environment organisations, academic or educational sites, and not for profit organisations. These immediately may give an indication to the user as to the perceived usefulness or potential quality. Ranking these with regards to reputability or reliability however is again less clear cut. For instance, has information from a small local newspaper owned by a multinational corporation the same quality or objectivity as the information from a major national broadcast corporation? What about a blogger with links to a well-known volunteer conservation organisation, a conservationist blogger without such connections or a blogger who used to work for a reputable newspaper? Consequently, developing a formula to establish a confidence rating system using weighted expressions to differentiate between the relevance of some of the attributes, such as the data source, is regarded as difficult. This is because in addition to ranking the different attributes, a hierarchy also exists within some attributes, which in turn can vary depending on the user purpose – in other words there are multiple sets of variables.

To clarify in more detail, Table 5.6 shows the same eight data attributes previously listed with hypothetical categories for each attribute. Some examples are provided for clarification purposes and it should be noted that the order of these categories does not imply a ranking per se.

There are many variables that can change in importance for different people according to the different purposes. Turning these into one ranking system would require either discounting issues or else result in many alternatives of the ‘if…, else…’ variety, both of which could render the system impractical. Developing such a confidence ratings methodology in practice is therefore a complex task that requires time and input from organisations, as well as expert knowledge to assist with the multivariate algorithms. An interactive model, where users tick which attributes are most important before a rating is
1. **Level of Parks Victoria control**
   - Parks Victoria project or site where users contribute specific data (for example a special crowdsourcing project asking visitors to collect specific data);
   - Parks Victoria project or site collecting any UCI (for example general public contributing photos or comments to Parks Victoria’s website);
   - Non-Parks Victoria project or site where users contribute specific data (for example OSM where users contribute geographic data);
   - Non-Parks Victoria project or site where users contribute any data (for example user comments found in response to an opinion piece on the ABC website).

2. **Data source**
   - Government organisations;
   - Media organisations;
   - Academic or educational organisations (for example Directory of Open Access Journals);
   - Not for profit / volunteer organisations (for example Victoria Naturally Alliance);
   - Businesses (for example Australian Human Resources Institute Centre of Excellence\(^93\));
   - Special interest / community groups (for example Atlas of Living Australia);
   - Social media sites with associations or credentials (for example blog written by Andrew McAfee, the author who coined the term Enterprise 2.0\(^94\) );
   - Social media sites without obvious associations or credentials (for example *Flickr*).

3. **Data contributor**
   - Expert (for example Bushfire Cooperative Research Centre or its researchers);
   - Professional (for example *The Age* or journalists writing for the paper);
   - Commercial (for example O’Reilly Media\(^95\), the online media company often associated with the term Web 2.0, or its employees);
   - Volunteer (for example contributors to the Atlas of Living Australia site);
   - Amateur or non-expert (for example a blog written by a bushwalking enthusiast, or reader comments on the ABC’s website).

4. **Data access**
   - Full data available on line, no need to join up to access;
   - Partly available online but need to join up for full access – free and easy to join;
   - Partly available online but need to join up for full access – restrictions on joining;
   - Online record providing limited details only – data available offline in full and for free;
   - Online record providing limited details only – data available offline with restrictions;
   - Online record providing limited details only – data not available offline.

5. **Search options**
   - Advanced search options;
   - Search within results;
   - Multiple keyword search;
   - Keyword search;
   - Limited search options, and need to manually search through information or Web pages.

6. **Level of detail**
   - Ranging from broad to in-depth detail.


\(^{94}\) Refer andrewmcafee.org.

\(^{95}\) Refer www.oreilly.com.
7. **Data purpose**
   - Factual;
   - Opinion;
   - Background;
   - Input data (for example to be used for further analysis, or as input for tools or models).

8. **Year of creation**
   - A series of time frames can be devised suitable or relevant to Parks Victoria.

Table 5.6 - Data attributes and examples of potential categories within those attributes for developing a confidence rating system.

provided may be a possible option. However, this would be less practical as it would require user input and thought and thus make the system, and tool, less effective. It would also not necessarily be less complicated because of the variations within each attributes. For example, not all blogs or media websites are of the same quality and *YouTube* hosts videos that are of dubious quality alongside videos that are useful and of high quality.

5.6.3.5 Two proposed solutions

It was clear that the quality and usefulness of data are difficult to assess objectively and transform into a single rating that can be attached to individual data. Two possible solutions were proposed to assist with this.

Firstly, take the notion posed that data attributes are indicators of data quality. One option is to attach these attributes to the data as tags and leave it up to users to decide what kind of data suits their purpose and where they want to look first. Someone writing a background story may need historic data, the author of a policy paper may need to review community opinions, whereas the production of a research paper may be aided by data obtained from governmental, educational or academic sources. Although a formal ranking originating from an authoritative source (in this case Parks Victoria) is useful as a guide, it ultimately depends on individual users’ opinions as to which data are suitable. The users in turn should also be able to add personal suggestions or observations about the quality and usefulness of data as they use them. This solution at first would not be particularly effective from a user’s perspective. Apart from a range of keywords that organises the data to assist their search, users would have to virtually make all assessments without any guide. Once the system is in place however and users have started to add suggestions and ratings, it would gradually turn into a more user friendly and effective system.
The second option is to look at individual attributes only, and define a rating system for each, where possible. Again, the onus would be on the user to decide which attribute is important to them and undertake a search accordingly. So rather than combining all attributes, resulting in one confidence rating system, a series of ratings can be attached for individual attributes. Table 5.7 is a sample matrix showing potential confidence indicators for the four classifications under the ‘level of Parks Victoria control’ attribute.

<table>
<thead>
<tr>
<th>Confidence indicators:</th>
<th>Parks Victoria project – specific UCI</th>
<th>Parks Victoria project – any UCI</th>
<th>Non-Parks Victoria project – specific UCI</th>
<th>Non-Parks Victoria project – any UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (5)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High to medium (4)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Medium (3)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Medium to low (2)</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Low (1)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 5.7 - Potential confidence indicators for four categories of the ‘level of Parks Victoria control’ attribute.

There are several issues that arise out of this approach. Firstly, it would be beneficial to reduce the number of attributes or else prioritise them to make the system more workable. The first three attributes of Table 5.6 (see page 207) – data source, data contributor and level of Parks Victoria control in the data creation – are regarded as the key attributes that influence data quality and usefulness. Attributes 4 and 5 – data access and search options – can be rated relatively easily if focusing on usefulness; fully and freely accessible data would rate higher than limited and restricted data access for example. The remaining three attributes 6, 7 and 8 are perhaps less able to be rated with respect to quality or usefulness as it depends on the user as to the level of detail they require, what kind of data they need, and how old or recent the data should be. The classification of these three attributes could therefore be attached as tags and would not be considered for the quality and usefulness assessment. Figure 5.26 depicts the resulting model: the first five data attributes are each divided into hypothetical classes with each class assessed and provided with a confidence rating. The user can select...
what confidence rating they require for different attributes depending on what they think
is important, and further refine the search by tags that include the remaining three
attributes.

The second issue is the aforementioned requirement for a hierarchy or formal rating
defined by Parks Victoria. One or more Parks Victoria representatives would have to
dedicate time and input, and decide which data sources are considered to be better or
more trustworthy and which ones are less so. This would have to be done for all
attributes. But even these ratings should be used as a guide only rather than becoming
an absolute measure. To further enhance the system, users of the data should be able to
rate the data and attach tags or comments. As with the first solution, the system would
become more effective once users contributed to the system as they were using it.

The end result is therefore regarded to be an evolving assessment model; as the data or
sites are being used, users can give their personal confidence ratings based on quality or
usefulness of the data for other users to consider. This is in line with the personalisation
of information and the bottom-up approach associated with Web 2.0. It is feasible that
data will end up being merely tagged as ‘additional data’. This would mean the system would not be as effective as it could be, as it would be up to each new user to assess the data for themselves every time without guidance. However, the data would still be on hand if required and easily available for users interested in further information. In the end, even without a clear confidence rating system in place, classifying the data and attaching a broad range of attributes including the ones listed in Table 5.6 would already provide additional information that could assist users in assessing the data’s suitability for their needs, thus, in essence, already making use of the GKT more effective.

5.6.4 The issue of variation in georeferencing

The GKT was defined by the research project as a knowledge system that, in part, provides access to data based on their geographic attributes. Data therefore need to be georeferenced or geotagged so that these attributes can be used to retrieve and present the data accordingly. This is arguably not straightforward when considering the variation in georeferencing that exists in both Parks Victoria’s data and the range of alternative data.

5.6.4.1 Observations for existing park management data

Let us firstly consider Parks Victoria’s existing data. Key data that are used regularly and accessible via various information systems are classified and stored in a hierarchical manner, so that they are found relatively easily. Two initial categories generally applied when accessing Parks Victoria’s data are teams (like departments) and management areas such as natural values management and fire and emergency management. These two categories are not geographic per se, although the physical location of a team is geographic. But like many organisations that are spread out geographically, a team’s location may not necessarily be a contiguous area. Regions, a subdivision of teams, is mainly geographic – the Central, West, East and Melbourne and Bays and Maritime Region regions have geographic boundaries - but other team subdivisions do not have such boundaries or else to a lesser extent. Regions are divided into districts, which in turn encompass individual parks. Parks Victoria’s structure of regions and districts are regarded as the two broadest geographic attributes applied.

Parks Victoria uses the regions and districts as initial geographic divisions for ParkView, its map based internal information system. For a general query, searchable geographic attributes include management areas (requiring regions and districts as
input), park names, work centres, place names and geographic coordinates. Specific queries can utilise non-Parks Victoria specific geographic divisions such as bioregions when completing a flora search.

The official data records maintained within TRIM are organised by work areas or units and topic. Although some work units and topics may have a clear geographic connection – the regions and districts or specific programs or projects associated with a geographic area like ‘Nine Mile Creek’ – these are accidental rather than deliberate georeferencing. These geographic descriptors would also be broad in nature; for example, research in a small area of a park in the Alpine District would only have Alpine District as its geographic attribute. Additional information can be attached to the record using free text but it is not mandatory to include a geographic reference here (J Wotton 2011, pers. comm. 10 August).

Geographic coordinates are generally applied to data covering smaller areas and point locations, or data within parks – some of these locations may not have geographic names and require descriptions instead. New data now being collected within parks have coordinates attached (J Whelan 2011, pers. comm. 23 February) using GPS devices, in line with a current initiative to distribute mobile GPS and GIS devices to park staff for field data collection. These geographic coordinates provide the most accurate geographic location, whilst various other geographic scales still apply (park name, region and so on).

Unlike the data in the internal map based system, other Parks Victoria data do not necessarily have a clear geographic attribute associated with them. As aforementioned, this is partly due to the non-geographic nature of two main organisational divisions (teams and management areas). There is also not a clear and appropriate geographic attribute in use for data at the broadest level; that is, data that apply to the whole park network or to Parks Victoria as an organisation. Any data that apply statewide are generally regarded as corporate, and may be associated with the organisation’s Head Office that has a geographic location (a building in Melbourne) rather than an area in Victoria (the geographical network of parks). However, such a point location may not be a very useful geographic representation for data applicable to the whole park network. Although some corporate data may only be applicable to staff or departments
at Head Office, statewide documents that apply to all parks and staff should be tagged accordingly so that they can be represented on a statewide map.

Other formal and non-Parks Victoria geographical divisions in place are also applicable to Parks Victoria’s data, yet the borders of some of these do not necessarily align with the borders of the organisation’s divisions. Bioregions were mentioned earlier, and fire management related data described earlier in this chapter also fit within a second geographical structure. Parks Victoria follows DSE’s geographic division for fire areas and fire regions that differ geographically from the organisation’s own divisions. WPNP thus sits in Parks Victoria’s East region and Wilsons Promontory District management structure, but for fire management the park falls under the Central fire region and South Gippsland fire district. Other parks in Parks Victoria’s East region however can fall under different DSE fire regions and fire districts.

Lastly, there can also be a variation in the detail or precision of the geographic attributes of data from different eras or sources; some data provide generalised geographic information that are broad in nature, whereas other data give more exact and precise geographic details. As an example, an Access database and GIS file were recently created at WPNP that contain details of research papers and reports held in filing cabinets about projects conducted in the park over the years. The attributes attached to individual records include a reference to the geographic location involved, and obtained from geographic information in the textual documents. It became clear that the accuracy of those geographic descriptions and details varied from specific to general (K Bennetts 2011, pers. comm. 02 March), resulting in a map that shows where research has taken place with varying certainty and precision.

5.6.4.2 Observations for alternative data sources
Alternative data sources that a GKT could draw on comprise existing digital data repositories and UCI – data contributed through participatory tools and applications. The location information of these data is variable and include differences in methods and formats, accuracy and precision, or even if there is a geographic reference. The ABC, for example, applies geotags to their articles in a standard format – ‘melbourne-3000’, ‘vic’, ‘australia’ and so on. Although geographic information contributed to crowdsourced projects like OSM most likely apply specified geographic attributes, with UCI in general specifying location is up to the users, hence a greater variation in
georeferencing exists. The Web 2.0 features of tagging and geotagging can be done through visible textual tags as found on Flickr or the ABC website, or using coordinates found in metadata. Images taken with GPS enabled cameras have such metadata attached and if uploaded onto the Web, these geographic coordinates can identify where pictures were taken.

There are a number of issues that need to be recognised with regards to geotagging of some of these alternative data sources and UCI in particular. Firstly, textual geotags that refer to the same place can vary widely. This is because of the personalisation aspect of Web 2.0 that lets users attach tags and geotags that make sense to them. Some people may use official geographic place names, whereas others may use variations or abbreviations of such names or use different terminology altogether – what Goodchild (cited in Gravois 2010) refers to as the democratisation of geography. Looking for example at the photos on Flickr that relate to WPNP, the most common tag used is ‘Wilsons Promontory’. There are already variations in this place name: it can be a single tag with space in between the two words, one tag but no space (wilsonspromontory) or two tags ‘Wilsons’ and ‘Promontory’. The term ‘Wilsons’ has variations too – ‘Wilson’s’ being the most common. Spelling mistakes are also made, with Promontory sometimes spelled without the ‘n’ (promontory) and Wilsons missing the final ‘s’ (Wilson). Then there are the more colloquial versions: Wilsons Prom, The Prom and Prom, with one or two tags and space/no space variations. The official geographical name Wilsons Promontory National Park is also used with multiple tags, as one tag with or without spaces (for example wilsonspromontorynationalpark), with National Park abbreviated to NP or written as one word, or with the same spelling errors as before. Locations in WPNP are tagged with similar variations and errors. Jones and Purves (2008, p. 221) identify the issue of “vague geographic terminology” when it comes to geographic information retrieval, which comprise these personalised and colloquial geographical terms. Whereas the latter may give clues as to the real location, the former can include references that may not. Consider tags like ‘Mum’s favourite beach’ or ‘Julie’s cabin’ that indicate a geographic location to the person that attached the information but will not make sense to most others. It is possible that a more exact location could be inferred by looking at other details such as other data uploaded by that user or their own geographic location, but that would not always be the case.
A second issue is the variation in accuracy and precision of the georeferencing, similar to the issue encountered during the creation of the research database described earlier in section 5.6.4.1. Apart from the correctness of the actual geographic location, there is the precision of the information. Geotagging an image with ‘Wilsons Prom’ is not incorrect per se, but if the image was taken at a specific beach, the Wilsons Prom geotag is not very precise. Similarly, the only town in WPNP is Tidal River where most people stay. Using this as a geotag for a picture taken somewhere else in the park may remind the user of their stay at Tidal River, but it is not geographically correct.

If digital data is also geotagged with geographic coordinates, this can alleviate the ambiguity of the textual geographic reference. Although only data generated with GPS enabled mobile devices are likely to have such accurate coordinates, these devices are becoming more commonplace, capturing an increasing variety of information apart from images. What does need to be taken into consideration in this instance is the difference between ‘source location’ and ‘target location’ (Amitay et al. 2004). That is, someone tweeting about their trip to WPNP (geographic feature) from a café in Melbourne afterwards and uploading images from their trip on their home computer means the geographic coordinates associated with the place of uploading (geographic source) can be ignored, and attention should be paid instead to the content and tags (geographic feature).

Finally, another issue identified by Jones and Purves (2008) with regards to UCI is also applicable to WPNP and Parks Victoria. The fact that some geographic place names have non-geographical meanings means that search results using the tags ‘Wilsons’ and ‘Prom’ on Flickr also produce images of an American school dance (a prom) from people called Wilson. And the non-geographical meaning of ‘tidal’ and ‘river’ means that Flickr search results for the tag ‘Tidal River’ in the first instance did not give any reference to the campsite in WPNP but instead showed Washington DC and Burton in Wales as the top geographic locations associated with the tag.

5.6.4.3 Discussion

It is argued that Parks Victoria’s data have a range of geographic scales or levels inherent within them although these are not always obvious or made clear, but can be inferred instead. This geographical hierarchy ranges from data applicable to the whole organisation down to an area or location within a park defined by geographic
coordinates (additionally there is a larger extent beyond Parks Victoria that encompasses Australia and beyond). Being in the business of park management, the vast majority of the organisation’s data are associated with one or multiple parks, an overarching district or region or else staff working in those areas, meaning Parks Victoria’s geographic attribute ‘work centre’ is applicable. If that is not the case, the broadest geographic scale should apply – data associated with Parks Victoria as an organisation and thus the whole park network. Even data from geographically dispersed departments can be assigned a geographic area, albeit not necessarily a contiguous one. Only very limited data, if any, seem not to be geographically linked at all.

Geographic coordinates attached to data generally provide accurate locations associated with those data. The increased use of geographic coordinates for field data at Parks Victoria will provide similar accuracies and improve geographic attributes. Geographic coordinates attached to UCI and other digital data, particularly if generated by GPS enabled devices, can be a useful means to position these alternative data sources and link them to appropriate Parks Victoria locations. However, these coordinates are not generally regarded as being useful when it comes to searching for data by location. This is simply because many people would not know exact coordinates and even knowing approximate ones might not necessarily lead to the correct location. Geographic coordinates are therefore useful to associate data with exact locations (give or take the GPS devices’ error margins), but additional geographic attributes using keywords or tags are required to make them more easily searchable.

5.6.4.4 A basic geographic framework

In order for a GKT to provide access to relevant data based on their geographic connections, a basic framework for geographic referencing is required. This geographic framework would house the various geographic scales and should recognise the different methods for geotagging that exist in both Parks Victoria’s own data and the alternative data sources. As a starting point, a geographic scaling method for the organisation’s existing data should be designed. This would incorporate geographic attributes already applied, as observed in their map based information system, and should consider referencing methods used in systems like TRIM and other geographic divisions in place such as DSE’s fire management structure. The system should combine or link official geographic names and Parks Victoria geographic terminology if they differ. This would be the fixed or formal component of the framework with
standards developed for georeferencing data with respect to geographic scales and names. All data should be georeferenced based on this formal geographical structure and multiple geotags should be applied if applicable so that data are being presented at all relevant scales.

In addition to this formal part, the system should also comprise a dynamic component. This would recognise alternative and informal georeferencing methods, and the range of variations with respect to formats and precision that is being applied to non-traditional data accessible via the Web. The dynamic component should subsequently link to the formal component by associating these informal geographic references with an official geographic location at the applicable level. Part of the process is for the alternative data to be tagged and geotagged appropriately so they are available when needed. The dynamic aspect of the system should include the ability by all users to add personalised tags to both existing and new data. When new data are being made available via the GKT, the formal georeferencing method needs to be applied, but informal geotags should be encouraged to enhance the user experience and effectiveness. This could be in the form of free format text, similar to the free format text that can be added to Parks Victoria’s official record management system, or it can be by attaching keywords similar to Flickr and Google applications. Figure 5.27 illustrates the various considerations for the fixed and dynamic components of the basic geographic framework.

It is suggested that the broadest Parks Victoria level that encompasses the whole organisation should not be classed as statewide, as it may clash with the overarching geographical area of the State of Victoria. Geographically speaking, the organisation’s park network does not entail the full State of Victoria but only parts thereof. Its partner in fire management, DSE, could on the other hand use statewide or Victoria as a geographic reference. The various levels that comprise Parks Victoria’s geographical structure in Figure 5.27 are not necessarily complete but can be used as a starting point.
Figure 5.27 - Basic geographic framework with fixed and dynamic components.
Devising a technical solution was outside the scope of the research project. How such a system would work in real life, how it can be developed or if technology exists that can do what is suggested has therefore not been discussed. However, considering the growth of research into geographic information retrieval (Jones and Purves 2008; Silva et al. 2006), no doubt a solution for building such a framework could be found should an actual GKT be built.

5.7 Developing a demonstration prototype

After the conceptual GKT, the second part of the case study was the development of a demonstration prototype. The purpose of the demonstration prototype was to assess the theories being applied. It would be a working, interactive model, albeit with limited capabilities, that uses aspects of the conceptual model. The ‘data in’ component was regarded as the most important for the purpose of the research project and subsequently for the demonstration prototype. The research’s two main objectives were to provide access to traditional and non-traditional data, and assess if access to the latter could benefit the former. How that access is actually provided, what personal tools users can utilise and the various ways the data can be organised were considered less important as such when it came to these objectives, and are therefore part of the conceptual model but did not become functional components of the demonstration prototype. Giving access to both traditional and non-traditional data on the other hand would provide reviewers the opportunity to form an opinion on the potential usefulness of having access to both types of data sources. This section describes how the demonstration prototype came about.

5.7.1 A proposed scenario and subsequent data needs

The demonstration prototype needed to provide access to a selection of data in order to demonstrate how a GKT would work. A possible use scenario was therefore required to assist choosing relevant data. Initially, a series of short scenarios were created that focused on the alternative data sources that might be encountered. These scenarios were hypothetical in nature and were specifically aimed at having to use some of the potentially relevant, non-traditional data identified during the investigative activities. Two sample scenarios developed at an early stage included:

1. A particular species, the Lizard Orchid or Bureattia Cuneata, has become prolific in a particular area of the park. How can it be managed? Options:
o Check what conditions are required for it to do well or blossom;

o Check if the area is due for burning soon by looking at the FOP;

o Check the *Environmental Protection and Biodiversity Conservation Act* website\(^{96}\) to ascertain if it is a protected species;

o Check if it is a weed using the online weeds database\(^{97}\); and

o Check if the species was in WPNP in the past.

Notes: According to WPNP’s EAP, this is a threatened species and needs fire to blossom and flower. The species is also listed on a 1909 document about WPNP obtained from the State Library of Victoria;

2. You want to read up on fire ecology and are trying to access RJ Whelan’s *The Ecology of Fire* from 1995, cited in the 2004 *Guidelines and Procedures for Ecological Burning on Public Land* by the DSE’s Fire Ecology Working Group;

o Is it in the Parks Division’s library, on the ninth floor of Parks Victoria’s Bourke Street office?;

o Is the book accessible from other sources? (for example from *Google Books* or the State Library of Victoria); or

o Are there other external sources that discuss fire ecology? (for example the AFAC Knowledge website or the Bushfire CRC website).

After due consideration and feedback, a more realistic use scenario was deemed more appropriate for the demonstration prototype, as it would be more capable of assessing the potential usefulness of the GKT. The preparations for an ecological planned burn at WPNP were underway at this stage (March 2011). After learning more about the process and data needs, and the clear relevance to ecological fire management, the preparations and associated data requirements for the planned burn were used as a guide to develop a simple but more representative use scenario.

**5.7.1.1 Overview of the planned burn**

The ecological planned burn considered was located on the Yanakie Isthmus, in the northwest part of WPNP, near the Park’s entrance. The burn was planned for the autumn of 2011 and appeared on the South Gippsland FOP available at the time\(^{98}\) (see

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\(^{96}\) The website referred to is www.environment.gov.au/epbc/index.html.

\(^{97}\) The website referred to is www.weeds.org.au/noxious.htm.

\(^{98}\) The burn appeared on the South Gippsland FOP for burns from 2010-2011 to 2012-2013. As FOPs cover three years and are updated annually, the South Gippsland FOP available online at time of writing (April 2012) is for the period 2011/12 – 2013/14.
The area was identified as a potential area to be burnt in WPNP’s 2007 FEA. The Assessment noted that there were no official fire records for most of the Yanakie Isthmus except for those areas that burnt during the 1951 fire. Although minor fires low in intensity may have occurred throughout the area until the early years of the 1970s, no proper records for these fires existed (Stoner 2007). Because of the absence of fires, large areas of the Yanakie Isthmus are now dominated by older coastal vegetation, and the previously open, grassy woodlands landscape has subsequently been invaded by Coast Tea-tree (*Leptospermum laevigatum*)\(^99\) (see Figure 5.29). The FEA further noted that the invasion of Coast Tea-tree into such areas has occurred elsewhere, and the Assessment suggested the use of “adaptive experimental management principles” (Stoner 2007, p. 76) to address the combined issue of lack of fire and increased grazing pressure – in particular kangaroos, wombats, cattle and rabbits have impacted on the health of Yanakie Isthmus’s grassy woodlands (Parks Victoria 2002).

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5.7.1.2 Preparations for the planned burn

The simple use scenario adopted was that a burn area had been selected, and planning for the burn needed to commence in order to obtain approval for the burn to take place. The planned burn preparations comprised four broad components (J Whelan 2011, pers. comm. 11 February) (see Figure 5.30). These were 1) defining the prescriptions for the burn, 2) the resources needed, 3) other management considerations such as Occupational Health and Safety, visitor and traffic management, and 4) other issues that broadly encompassed what assets were on the ground in the area to be burnt.

The process for obtaining relevant data is reasonably straightforward for the first three of these components (J Whelan 2011, pers. comm. 7 April). It is also more or less fixed through procedures and guidelines already in place. This is particularly the case for the ‘resources’ and ‘other management’ components. The ‘prescriptions’ section also relies on existing data that are readily available from Parks Victoria’s corporate drives or information systems like InfoWeb, ParkView and FireWeb. However, some input data still need to be gathered such as the available fuel in the burn area, and therefore form part of the pre-burn monitoring section of the ‘on the ground' component. This last component primarily revolves around what assets and values exist in the burn area that may be affected by the fire. These assets can be natural, cultural and built. The effect of
the fire on these assets can be assessed through both pre- and post-burn monitoring. The knowledge gained from this monitoring process can be used for the preparation of future fires, and inform and enhance existing systems and guidelines.

### 5.7.2 Data for the on the ground component

The fourth ‘on the ground’ component was the least fixed part of the preparation process with regards to data sources, and became the focus of the use scenario for the demonstration prototype. It particularly considered the pre-burn monitoring of natural values that were or could be present in the burn area. The questions that needed answering therefore was what data are used to find out what the natural values in the burn area are, and how these might be accessed or obtained.

#### 5.7.2.1 New data collection

The ‘on the ground' component broadly involves collecting new data using existing tools or data as appropriate. New data are collected at a local level as part of the pre-burn monitoring phase to establish what assets exist. The information for this section on
new data collection was primarily obtained from conversations with the Operations Manager at WPNP and ensuing email communications.

In order to know what new data need to be collected, it is important to understand the objectives of a planned burn (J Whelan 2011, pers. comm. 07 April). The two primary aims for the Yanakie Isthmus planned burn were in line with the recommendations outlined in the WPNP’s FEA (Stoner 2007) and were 1) to reduce Coast Tea-tree cover, and 2) to increase available fuel in preparation for a second burn. This second burn is to take place in about five years from the first burn, with the aim of killing off any regrowth of the Coast Tea-tree that has occurred in that time (J Whelan 2011, pers. comm. 07 April). The first two questions that needed answering as part of the pre-monitoring stage were therefore: what is the current coverage of Coast Tea-tree, and what fuels are currently present? Finding out this information provides the opportunity to measure the changes after the event as part of post-fire monitoring. The third question asked what other assets were, or could be, present in the burn area on which the fire might impact. The focus was on natural values and included an assessment of the potential existence of threatened species.

The primary focus of the pre-burn monitoring activity was to investigate the effect of fire on two Ecological Vegetation Classes100 (EVCs) - Calcarenite Dune Woodland and Calcareous Swale Grassland. The former comprises shrubs such as the Coast Tea-tree that are now invading the latter EVC as a result of overgrazing and inappropriate fire regimes. The Calcareous Swale Grassland EVC represents the grassy woodland to which experts say the Yanakie Isthmus should be returned (J Whelan 2011, pers. comm. 18 April). Fifteen monitoring sites of 20 metres by 40 metres were established across the burn area. These were identified using aerial imagery and local knowledge. Detailed data were collected from six quadrats of 2 x 2 metres within each monitoring site (see Figure 5.31), and locations were recorded for each corner using GPS (J Whelan, pers. comm. 13 April).

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100 EVCs are a means to classify native vegetation in Victoria (Department of Sustainability and Environment 2011). Each of the approximately 300 EVCs represents a plant community with similar characteristics and are used for biodiversity planning and conservation assessment (Victorian Resources Online 2011).
5.7.2.2 Data requirements

The following section provides an overview of the data that needed to be collected, some of which relate to elements of Figure 5.31. It also describes existing data used, where applicable, and some limitations identified during the process.

- A sequence of aerial photos was used to assess Coast Tea-tree coverage and age. Generally, this imagery would have to be acquired specifically for the burn. In this instance however, existing imagery from a previous research project was used. Only one local staff member knew these photos existed. Therefore, without the personal involvement in the burn preparations of this staff member, the imagery would not have been identified as suitable and thus not be used for this task;

- Trees that intersected the 40 metres borders of the monitoring site were counted to further assist the assessment of the Coast Tea-tree density. The intersecting trees’ height category and flowering stage\(^{101}\) were also determined;

- The fuel availability of the site was assessed using DSE’s *Overall Fuel Hazard Assessment Guide*\(^ {102}\), which provides a supplementary fieldwork sheet (Hines *et al.*

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\(^{101}\) Height categories for tea-trees were the following: 1 = 0-0.5m, 2 = 0.5-1m, 3 = 1-2m, 4 = >2m. The flowering stage or reproduction categories to be identified could be flowering, budding or capsules (Source: Yanakie flora monitoring methodology November 2010).
2010). Ratings for the different types of fuel - fine fuel, surface, near surface, elevated and bark fuel - were recorded for the site; and

- The location of three key canopy tree species were recorded (using GPS) if they were of a particular size, and their diameter was determined. The trees were tagged to enable identification after the fire and assess the effect of the fire (J Whelan 2011, pers. comm. 18 April).

Additional fieldwork activities specific to the six 2 x 2 metres plots were:

- Detailed assessments of vascular and fern flora species were conducted by estimating the percentage of foliage cover. Additionally, the cover of bare ground, litter (leaves etc.) and other ground cover was recorded;
- Data loggers were put in to measure soil temperature at depths of 2 and 5 centimetres;
- Cameras were set up to capture images at certain time intervals to assess the fauna species present; and
- Finally, images were taken to provide a general overview of each plot (J Whelan 2011, pers. comm. 13 April).

Flora and fauna information is accessible through ParkView or, in raw GIS format, from Parks Victoria’s corporate drives. However, the geographic attributes of the data generally refer to broad locations rather than specific ones. The threatened species GIS layer, for example, shows which particular species are known to be present in the park but it does not show exactly where they are in the park. These corporate data therefore can serve as a guide, but additional research is generally needed to better assess the likelihood of a particular threatened or rare species being present in the burn area. In the case of the Yanakie Isthmus burn, the likelihood existed that the rare New Holland Mouse (*Pseudomys novaehollandiae*) (see Figure 5.32) was present (Department of Sustainability and Environment 2003).

\[102\] In practice, documents at the different levels of fire management described earlier in this chapter are not generally utilised during these pre-burn monitoring activities with the primary exception the statewide *Overall Fuel Hazard Assessment Guide*, a tool to assist with assessing fuel levels (J Whelan 2011, pers. comm. 07 April).

\[103\] The system to estimate project foliage cove is + = <5% (few individuals), 1 = <5% (many individuals), 5 = 5%, 10 = 10%.
Although not specifically applied for that purpose, the cameras used to identify fauna species could theoretically also have captured images of a New Holland Mouse. As this was highly unlikely to happen in reality, alternative investigations into the possibility of the threatened species being present in the burn area were undertaken. These included the steps described below:

- All current reports on the New Holland Mouse assembled into a local database\textsuperscript{104} were forwarded to DSE and a GIS layer was generated;
- A Web search was conducted to determine if new reports on the New Holland Mouse existed that were not contained in the database. A previously unknown report was found and was added to the database; and
- A Biodiversity Officer in the DSE Yarram Office was contacted to assess the possibility of the species being present in the burn area. The Officer is considered an expert on the New Holland Mouse due to their involvement in monitoring projects of the species at WPNP. The Officer’s knowledge was regarded to be the most accurate available at the time.

\textsuperscript{104} The local research database was created in 2010 and records all hard copy and digital research papers and reports available at WPNP. The records comprise a range of attributes including geographic ones that can range from an exact location to a broad area description.
An issue to be noted is the importance of networking, and knowing whom to contact for expert advice. Additionally, it is about providing a means to identify other people’s knowledge. A Parks Victoria staff member involved in the burn preparations knew the Biodiversity Officer at the DSE Yarram Office and was aware of their expertise. Through this contact, it became possible to also tap into the expert knowledge of an ex-DSE staff member, now working for a local shire.

After preparations were complete and the burn was approved, it was added to the South Gippsland FOP and became available to the public for comment. Details of the planned burn can be amended based on feedback received, with subsequent approval needed until the burn is lit on the actual day. In the case of this particular burn, it became apparent that not all assets had been accounted for. Researchers from Latrobe University contacted WPNP after seeing the planned burn on the FOP to enquire about the research plots they used, and which were located in the burn area. These research plots were not identified at any point during the pre-burn preparations because they were truly ‘local’ data – their existence and locations were only known to Parks Victoria staff that had dealings with the researchers. Although a WPNP staff member involved in the burn preparations was aware of the plots’ existence, the process did not provide a ‘cue’ to remember the plots were relevant. They did not form part of any existing GIS data layer nor was there a checklist to trigger the memory.

Finally, a number of other issues could also benefit preparations for a planned burn. These include events such as elections – the burn planned for autumn 2011 was initially due to take place six months earlier but was postponed because of its proximity to the Victorian state election – or high visitor periods; burns are not approved if planned in the lead up to or during peak tourism times. Information about activities by other stakeholders that could impact on the ability for a planned burn to go ahead because of clashing priorities was also considered useful (J Whelan 2011, pers. comm. 11 April).

5.7.2.3 Data collection during and after the fire

Before moving on to the next topic, some of the data collected during and after the fire are being noted. These, although outside the scope of the use scenario, aim to complete the planned fire preparations ‘story’. Because it is not known what conditions are needed to burn Coast Tea-tree successfully, and because the fire was part of an adaptive experimental management project, constant measurements would be taken during the
fire – air temperature, wind direction and speed, as well as soil temperature. The latter is measured because of its importance to the assessment the regrowth conditions of the tea-trees. These measurements would be used to analyse the results of the burn, and could be considered and adjusted for the second burn or any other future burn. For example, if a certain soil temperature resulted in a higher than expected regrowth of the Coast Tea-trees, it would need to be ensured that the conditions during a next burn would result in a lower soil temperature by undertaking the burn when conditions are less volatile or soil moisture is higher. It is therefore important to store and classify these records appropriately so they would be easily retrievable when needed again.

One final fieldwork activity that would need to be completed as part of the post-fire monitoring process is the measuring of the impact of grazing on the available fuel. Too much grazing for example, may reduce the available fuel needed for the follow up burn in five years (J Whelan 2011, pers. comm. 07 April).

5.7.3 Data needs for the demonstration prototype

The demonstration prototype needed to provide access to a selection of data in order to demonstrate how a GKT would work. Section 5.7.2 described a broad range of data requirements for planned burn preparations. It primarily focussed on new data obtained through fieldwork activities – the ‘on the ground' component of the preparation process. Some of these data, such as soil temperatures and detailed flora assessments, were regarded to be outside the scope of the demonstration prototype primarily due to their non-digital aspect. Such data are obtained in the field using measuring devices like thermometers and GPS, and Web based representations or alternatives do not exist or were not deemed suitable.

The focus therefore was on data useful to determine what natural values were or might be present in the burn area. Table 5.8 summarises specific data to which the demonstration prototype could provide access, based on the planned burn preparations described earlier. Added to the table are key documents at various fire management levels. Although these are not generally utilised during this process in practice, these traditional data were added because they were regarded to provide guidelines and planning frameworks, and could be used as a reference point or source of information that may be required at any point during the planned burn preparations (whether that actually happens in practice or not). Additionally, they ensured a sufficiently broad base
| Legislation |
|-----------------|-------------------------------------------------|
| - *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* | → From relevant Act’s website |
| - *Flora and Fauna Guarantee Act 1988 (Vic)* | → From Victorian Law Today Library Website |
| - Action Statements associated with the *Flora and Fauna Guarantee Act 1988 (Vic)* | → From DSE website |

| Statewide |
|-----------------|-------------------------------------------------|
| - Code of Practice for Fire Management on Public Land | → From DSE website, InfoWeb or FireWeb |
| - Guidelines & Procedures for Ecological Burning on Public Land | → From DSE website, InfoWeb or FireWeb |
| - Overall Fuel Hazard Assessment Guide | → From DSE website or FireWeb |
| - Corporate flora and fauna data | → From corporate hard drive (raw GIS data) or ParkView (presented in map form) |
| - Threatened species GIS layer | → From corporate hard drive (raw GIS data) or ParkView (presented in map form) |

| Fire area / fire district |
|---------------------------|-------------------------------------------------|
| - South Gippsland Fire Operations Plan | → From DSE website, FireWeb, locally stored digital and hard copies |
| - Fire Ecology Assessment for WPNP | → From FireWeb, locally stored digital and hard copies |

| Local (WPNP) |
|-----------------|-------------------------------------------------|
| - Environmental Action Plan | → Locally stored digital and hard copies |
| - Management Plan | → From InfoWeb, locally stored digital and hard copies |
| - Research database comprising research reports at WPNP | → Locally stored GIS file (in progress and to be transferred to corporate drive when completed) |
| - Aerial photos from a previous research project | → Locally stored hard copy |
| - Research plots from other projects | → ‘Hidden’ in locally stored research files, mainly known by individuals involved in or aware of research |

| Other data (external) |
|-----------------------|-------------------------------------------------|
| - Events calendar to check for elections, school holidays/holiday season | → From Victorian and Federal Government websites |
| - Activities calendar for stakeholders | → Does not exist so would currently need to contact individual stakeholders |
| - New research reports on the New Holland Mouse | → Web search |
| - Expert knowledge | → Through existing contacts and personal knowledge of who are experts |

Table 5.8 - Summary of data requirements for the demonstration prototype and data sources.
of traditional data for the demonstration prototype. Table 5.8 also shows where these data are stored or how they can be obtained.

As shown in Table 5.8, the majority of the data is accessible via traditional sources such as Parks Victoria’s InfoWeb, ParkView and corporate drives, or from trusted websites like the DSE site and Victorian Law Today Library. However, the question needed to be asked if some of these data could be obtained from alternative sources instead, or else, if relevant data from other sources could enhance the traditional data and, for example, provide additional information or insight into the why or what that could benefit the data user. Taking into account the range of potential data sources identified as part of the conceptual GKT (see previous Figure 5.9, page 157), these could include data from stakeholders, other organisations or existing digital repositories on the Web. For instance, images posted on Flickr could assist in determining the likelihood that a certain flora or fauna species is present in the prescribed burn area. Asking these questions addressed the key objectives of the research project: 1) provide access to traditional data; and 2) provide access to alternative data sources and assess if they can potentially complement the traditional data.

5.7.3.1 Expanding the perspective of use scenario and accessible data

In order to address the second objective – the premise that alternative data might potentially complement traditionally data –, the data requirements identified in Table 5.8 needed to be expanded. Additionally, the simple use scenario needed to be viewed from a broader perspective and the alternative data portion of the dataset to be similarly expanded. Although this would make the use scenario more hypothetical, unlike the initial scenarios considered (see section 5.7.1), the broader scenario was still based on an existing and real activity. This expanded view would provide reviewers of the demonstration prototype access to a greater variety of non-traditional, arguably relevant and potentially useful data for the purpose of providing additional information or insight, giving background details or being a means to refresh existing knowledge.

Taking the use scenario of the ecological, planned burn preparations on the Yanakie Isthmus, and considering the data requirements identified already, a number of related topics proposed were:

- Information on Coast Tea-Tree;
• Information on EVC’s, and particularly the Calcarenite Dune Woodland EVC and Calcareous Swale Grassland EVC;
• Information on the Yanakie Isthmus;
• Information on fuel hazard assessments;
• Information on flora and fauna species identified;
• Information on threatened species; and
• Information on fire ecology.

Figure 5.33 shows the proposed dataset that the demonstration prototype should provide access to, to assist in addressing the research project’s key objectives. The data examples listed are based on the broader use scenario. The Statewide, Legislation, Fire area/fire and district data are traditional, whereas Local, Other and Additional data show examples of both traditional and alternative data.

Figure 5.33 - Proposed dataset for the demonstration prototype based on a broader use scenario.

5.7.3.2 Limitations on data selected

It should be noted that the data examples for the demonstration prototype were chosen and deemed relevant by a non-expert on park management and were aimed at demonstrating the variety of potentially relevant data that exist. The notion that potentially relevant data exist would have been diminished if, for example, WPNP rangers had been asked to choose examples of potentially relevant data instead. The demonstration prototype would most likely have provided access to only relevant data, as chosen by the park rangers, and assessing if the alternative data would be useful
would therefore supposedly return a ‘yes’ answer. Getting park rangers to choose what data are relevant is effectively the next step in the process, as users of the tool assess the alternative data presented to them for quality and usefulness (the aforementioned evolving confidence rating system).

The demonstration prototype in the end would not provide access to all data proposed in Figure 5.33. All data did become part of the prototype as passive examples, but only some became interactive components showing more detailed information or providing data access. This was for various reasons, including the overall amount of data now being vast rather than necessary, but mainly for it being outside the technical scope of the research to be able to do so. For example, it was not technically possible to provide access to Parks Victoria corporate GIS data, the research database (also GIS files) and the non-digital aerial imagery at a local level. Additionally, a few data listed did not actually exist, like a system that records details about research plots within WPNP or a calendar that provides information about stakeholder activities, both of which were identified as being useful to have access to during planned burn preparations. As it was outside the scope of the research project to develop such systems, including them as examples merely noted that these data were identified as being useful for the preparation of planned burns. The research database at WPNP was the result of an interested staff member that saw the benefit of such a database, and the two aforementioned systems could evolve in a similar fashion. For example, a calendar could be developed similar to the ‘What’s On’ calendar aimed at visitors on Parks Victoria’s new website but instead could be aimed at staff to inform them of stakeholders’ activities being undertaken where and when (requiring the necessary Parks Victoria resources of course to develop such a system).

The alternative data added to the demonstration prototype encompassed UCI in its broadest sense, as defined by the research project (see section 1.2.3). It comprised examples of data found on the Web as well as local organisational data that have not traditionally been accessible by staff members other than those aware of the data’s existence. There were further examples of UCI in the original sense – data contributed by the general population through social media applications – such as a link to photos uploaded by the Wilsons Promontory National Park group on Flickr. Perhaps as a result of the technical limitations of the demonstration prototype, described above, an analysis

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of the feedback received by reviewers of the demonstration prototype showed their appreciation of having potential access to some types of alternative data whilst they do not explicitly embrace all. Please refer to the ensuing Chapter 6 for a detailed description of the feedback received, and section 6.2.1 specifically for initial responses to the inclusion of alternative data.

5.7.3.3 Issues with data requirements

The overview of data requirements for the preparation of the planned burn revealed a number of issues that were at the core of this research project, some of which also formed part of the conceptual GKT. The first issue comprised the ‘localness’ of data, with only people involved in the data’s creation aware of their existence. This was encountered several times - the existing aerial photography from a previous research project on Banksia dieback and the Latrobe University research plots. In each case, only limited staff members were aware of these data’s existence. In part associated with this was the tacit or expert knowledge that people possess as observed in the knowledge exchange on the New Holland Mouse. Again, one staff member was acquainted with this expert and was thus able to ask their assistance. A system that identifies different expertise people possess and how to contact them seems useful. Considering the Knowledge Nuggets project mentioned previously in Chapter 3.2.2.3, it seems pertinent to extend the knowledge exchange taking place in this project beyond Parks Victoria’s Canada Exchange program that it currently covers

Another issue identified is linked to the existing aerial imagery of a previous research project that investigated Banksia dieback. Only one person involved in the burn preparations knew the images existed. If the files associated with the research were stored using keywords, they may still not have been found because the species and purpose involved in both projects differed – Banksia versus Coast Tea-tree and disease management versus fire management. It is therefore important to attach keywords that cover a much wider range of issues or topics that data could be potentially useful for – the multi-faceted classification systems described in Chapter 3. Attaching appropriate geographic attributes is but one part to ensure data are discovered when searched for.

106 Dieback is a plant disease that affects certain species including Banksias. Refer for example www.dieback.org.au/go/what-is-dieback/susceptible-species.
Finally, the issue described previously in section 5.6.4 concerning variation in georeferencing of data has emerged here. The traditional flora and fauna data, embodied by the GIS layer for threatened species, do often not identify specific locations but only broad ones. The same applies to geographic locations attached to the research papers found in WPNP’s research database. When the research database was completed, the geographic attributes of the content were mapped. The resulting map depicts areas ranging from broad and generalised to specific point locations. Just like the threatened species data, any broad geographic locations may merely be useful as an initial indicator.

5.7.4 Designing the demonstration prototype

Having established a use scenario and basic dataset for the demonstration prototype to provide access to, the next step was designing an actual prototype and interface. As with the conceptual model, initial ideas were drawn using pencil and paper, whilst Pencil\(^\text{107}\), an OS sketching and prototyping software, was used to create examples of how some of the paper designs might look. The final interactive version of the demonstration prototype would be a Flash movie, developed with Macromedia Flash software (now owned by Adobe). Individual members of the interdisciplinary Affective Atlas team that the research project fell under provided feedback at several stages during the design process. This section describes the overall design process of the demonstration prototype and interface.

5.7.4.1 Early design ideas

When brainstorming design ideas for the demonstration prototype, an early idea that emerged was that although the GKT could potentially be a standalone tool, it made sense that it could also easily provide access to Parks Victoria’s current data and information systems. Data in the organisation’s main information system InfoWeb are primarily organised based on the internal management divisions and subdivisions within each. The higher-level divisions in particular are non-geographic in nature, and in order to give an organisational overview of this non-geographical structure, the concept of a treemap could be useful. Treemaps are able to display hierarchically structured information within a rectangular construct and are regarded as space saving (Johnson and Shneiderman 1991). Applying a treemap for the opening page of the GKT would provide a one-page tool to Parks Victoria’s hierarchical structured data. Individual

elements within the treemap would be interactive and clickable, and become the access point to data.

Although the treemap was regarded as a useful means to represent Parks Victoria’s organisational structure, care was taken to not merely reorganise InfoWeb, the existing information system in use. The front page of the prototype therefore would need the ability to include alternative data sources. For example, if the WPNP subdivision of the treemap was clicked and the option to include alternative data was selected, the results would display any data currently showing under the equivalent tab in InfoWeb, any other existing Parks Victoria data and existing Web archives tagged with this subdivision (WPNP). Figure 5.34 shows an early design home page using a treemap to visualise Parks Victoria’s organisational management structure.

Figure 5.34 - Early design of the demonstration prototype’s front page depicting Parks Victoria’s organisational structure using a treemap. WPNP is shown as one of four yellow rectangles, nested within the East region subdivision of the Regional management division.

WPNP is one of the four subdivisions of the East region. It is depicted as one of four small dark yellow rectangles (towards the left bottom portion of the image) that are nested within the East region subdivision, one of five subdivisions of the main Regional
management division. Figure 5.35 shows the results page for selecting the WPNP subdivision. The relevant data are listed in the grey column on the right, whereas the map represents the appropriate geographic attribute.

Figure 5.35 - Results page after selecting the WPNP Regional management sub-subdivision on the home page. The relevant data are listed in the grey column on the right, whereas the map represents the geographic attribute.

In addition, it was envisaged that the front page could be used to complete an advanced search (the grey column on the right in Figure 5.34). This search would be based on keywords, geographic location and confidence rating. Figure 5.36 visualises how the results of such an advanced search might look. The grey column on the right hand side again depicts the data results and the map shows the relevant geographic area.
Due consideration was given to the question whether this treemap opening page was actually needed, or if it was a design element that would merely provide an alternative method to existing systems like InfoWeb. If the latter, it would be a superfluous step that could be replaced simply by adding hyperlinks to these systems so they could be used instead. Additionally, it was suggested that there was no consistency between the home page and the ensuing results page, that is, there was a complete change of design, which was not regarded as being very user friendly. In an attempt to maintain consistency, the treemap design was also applied to the result pages (see Figure 5.37). The results were divided into categories like corporate, legislation or social media, and displayed in treemap-like rectangles representing the categories housing relevant data. Users could tick a radio button if they wanted to select a particular data item. The map representing geographic attributes was displayed in the grey right hand column in this design.
More feedback suggested that this would not be a particularly user-friendly design, as users would need to tick many boxes and buttons to see the data they wanted. Furthermore, the various elements of the site were not arranged in an effective, balanced manner. For example, to make room for the results in the treemap, the map portion was moved to the grey column on the right. This was not ideal however, as the map was now too small in size and any detailed geographic information would be difficult to read. Although it was supposedly possible to enlarge the map by clicking on a link, this would require extra user input again. Additionally, it would not show the treemap results and the map with associated geographic locations side by side, which was regarded to be beneficial and an essential component of the tool.

5.7.4.2 Expanding the treemap design idea

The concept of the treemap appealed however, and to improve the demonstration prototype’s design and usability, the design and functionality of Newsmap was considered (see Figure 5.38).

108 Refer newsmap.jp.
Newsmap is an application that visually displays news stories from Google News as they are being changed and updated (Weskamp 2011). The blocks size represents popularity of the stories, colours represent topics comprising seven categories, whilst three levels of grey-shading applied to the coloured blocks symbolise how old the stories are. For the demonstration prototype, blocks of the treemap could similarly automatically update as people choose a geographic area or select keywords. To solve the map issue, it was decided that the map and data area could sit above each other and users could adjust the size of either area as they deemed appropriate with a simple drag action. Figure 5.39 is an early version of the redesigned interface, with the choice of bold and bright colours used for the treemap somewhat influenced by Newsmap at this stage.

Using such a treemap design would add to the usability of the site compared to earlier design ideas, as users do not need to continuously tick multiple boxes to make selections as they move through the tool. Having to click often is generally not considered good usability practice (Usability.gov n.d.), although there are different theories that suggest it can depend on the utility and design of the site according to Chapman (2010). Users of the demonstration prototype would still need to select blocks if they wish to save or view them, but it was argued that this would not necessarily affect the usability because of the way the prototype was designed and functioned.
The interface design was now considered suitably established so that the first version could be made in Macromedia Flash. Flash is used to create interactive components of Web pages, or to create a complete interactive Web page or site as a Flash movie (.SWF extension file) (Adobe 2012). The software was formerly a Macromedia product, and Macromedia Flash 8 was used to develop an interactive demonstration prototype.

To improve the design and usability, the first version made in Flash firstly saw a change in colour scheme. The new colours, five shades of green and five shades of yellow-orange to represent the five categories of traditional data and alternative data respectively, were colour-blind safe colours derived using the online Colorbrewer tool\textsuperscript{109}, and adapted to colours of the Web safe colour chart\textsuperscript{110}. Secondly, items of the initial interface design were rearranged, and the tabs representing the data and the slider used to select confidence ratings were moved above the treemap to improve usability (see Figure 5.40). The four user options available to refine results were now placed in

\begin{itemize}
\item \textsuperscript{109} Refer colorbrewer2.org.
\item \textsuperscript{110} Web safe colours are a palette of 216 colours that are regarded to display the same on all computers that support a maximum of 256 colours (W3Schools.com 2011b). The colour scheme came about some years ago when computers were capable of displaying only 256 colours.
\end{itemize}
close proximity to each other at the top half of the screen, allowing for easy accessibility and interaction.

Figure 5.40 - First version of demonstration prototype made in Macromedia Flash: data are presented in blocks whilst geographic attributes are represented on a traditional map.

5.7.4.3 Moving to a vertically oriented design

One major change was yet to occur after receiving feedback on this first design. The advice suggested that the user process of matching individual data tabs with the applicable data blocks in the treemap was not instinctive. This was particularly the case for the alternative data that formed the lower half of the treemap (the yellow/orange shades), but it also applied to the traditional data sources (the green colours). Users would have to move their eyes around the treemap to find data applicable to a particular category, albeit guided by matching colours. The solution proposed was a vertical design that arranged data blocks vertically under each data category tab. This would group all data relevant to a particular category directly under the relevant header, thus providing a visual guide to find appropriate data results more easily. Figure 5.41 compares the original block design, comparable to Newsmap’s layout, with the vertical
division considered for the demonstration prototype. The latter was regarded to work better here and improve usability, compared to the block structure in place in Newsmap.

Figure 5.41 - Tabs with block design similar to Newsmap versus the vertical design considered for the demonstration prototype.

Figure 5.42 is the revised design for the demonstration prototype applying the vertical block arrangement.

Figure 5.42 - Redesigned treemap using a vertical arrangement and simplified interface showing only necessary elements.

Because this solution required a major redesign of the Flash working file, the overall interface was also reassessed at this point. Interface elements regarded as unnecessary
and cluttering the overall design were discarded, including the image header and left column with instructions. The new design as seen in Figure 5.42 was regarded as a cleaner, simpler interface that only took in necessary elements.

5.7.4.4 Colours representing the confidence ratings system

One final major change made concerned the way data confidence ratings were represented. For the purpose of the demonstration prototype, the ratings system used numbers from five to one (discussed in ensuing section 5.7.4.5). Initially, small red or white numbers – the colour depending on legibility in relation to the block colour – were placed in the top right corners of the alternative data blocks to show the confidence rating of a particular data item (a block) (see previous Figure 5.40, page 241). However, feedback suggested that the use of darker and lighter colours might be a more instinctive method to represent these ratings. This value attribute, representing the change in a colour from light to dark, is one of Bertin's (1983) seven visual variables. The variables – position, size, shape, colour, value, texture and orientation – each have different functionalities. According to Dent (1999), variations in value and saturation allow for quantitative differences to be visualised, whereas varying colour or hue is useful to depict quantitative differences. As aforementioned, the Newsmap application uses variation in value to represent how old news stories are.

Although the original 10 colours were regarded as appropriate, they needed changing to incorporate the variation in value or saturation required for the ratings. A variant of a Munsell colour system\(^{111}\) was considered briefly (see Figure 5.43), but the original broad colours would in the end remain. Green was chosen as being representative of park management data (‘parks are green’) and thus depicted traditional data. Red is green's complementary colour\(^{112}\), however, as it was regarded as difficult to create five distinct red colours, a red/orange/yellow range would depict alternative data.

\(^{111}\) A scientific methodology to define colours in terms of hue, value and chroma developed by Albert Munsell (Cleland 2005).

\(^{112}\) Complementary colours are those on opposing sites of a colour wheel that comprises 12 colours (three primary colours, three secondary and six tertiary) (Color Matters 2011).
The 10 final main colours were picked by eye to match the original colours where possible, whilst bearing in mind they had to be distinguishable at the same time. A colour-blind person subsequently confirmed that this was the case. Each colour required five shades of varying lightness to represent the confidence ratings system. The saturation of the main colour was reduced by 20 and the value increased by five, whilst the subsequent shades had their saturation reduced by 10 and the value increased by five. For example, the HEX codes for the five shades of the first green colour are: 336600 – 457317 – 538026 – 628c38 – 73994d. There were a few exceptions when the value of the original colour was already 100 – particularly the case for the darker yellow and orange colours – in which case only the saturation was reduced. Figure 5.44 shows the final selection of colours and shades thereof, and their HEX codes.

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113 HEX codes are hexadecimal notations that represent the combination of Red, Green and Blue (RGB) colour values of a colour (W3Schools.com 2011b).
114 Thanks to an online conversion tool from www.rgbtool.com, this was made into a relatively easy task.
Figure 5.44 - Final selections of colours and shades and their HEX codes, representing different data types and range of confidence ratings (5 – 1) within each type.

The HEX codes shown in the above figure reveal that the method described for obtaining colours, resulted in colours that were not part of the Web safe colour palette anymore. However, statistics from January 2011 suggest that not many computers remain that only display 256 colours (W3Schools.com 2011a), hence the need for the Web safe colour palette has become somewhat obsolete.

**Error! Reference source not found.** shows the final interface design of the demonstration prototype with colour coding applied to alternative data, before its review by stakeholders (see Appendix X for an A3 size version of this final interface). Please note that any dots that may be visible – red or black – indicate interactive components, and were for the purpose of the demonstration prototype's review (described in section 5.7.6).
The data blocks of the treemap until this point in the design process did not have a meaning attached other than that the colour represented a particularly data classification (as represented by the 10 data class tabs). This is unlike *Newsmap*, where block size and grey-shading represent different attributes (Weskamp 2011). However, with the final design of the demonstration prototype, data blocks were given a second variable based
on the confidence rating. Different shades within a data class colour represent confidence ratings five (highest and darkest shade) down to one (lowest and lightest shade), although their size was still arbitrary. It is conceivable that in a working GKT, the variable of size could also be taken into account such as to similarly represent the popularity of a data item. This could be based on usage, or added user ratings or comments for instance.

5.7.4.5 Other design considerations

The demonstration prototype has been designed for screen resolution 1024 x 768. Computer screens at Parks Victoria vary in size and they do not have one standard resolution. A check of a number of desktop computers at the organisation’s Head Office showed screen resolutions of 1280 x 1024 and 1440 x 900. Some staff use laptops on a regular basis, with general screen resolutions of 1366 x 768 and 1440 x 900. According to W3Schools.com (2011a), 14% of visitors to the company's website had a screen resolution of 1024 x 768 whilst 85% had a higher resolution. As the figures for average Internet users may admittedly be lower, the demonstration prototype's chosen resolution of 1024 x 768 seemed appropriate. It would cater to the minimum requirements of Parks Victoria users and to most other non-Parks Victoria users. It is envisaged nonetheless that a working GKT could be designed in a flexible manner with an interface adaptable to the screen resolution of the user, if deemed appropriate.

The demonstration prototype visualised a confidence rating system that used ratings from five to one; five represents potentially high quality and/or usefulness, and one either low quality/usefulness or else that nothing can be said about it. The confidence ratings applied to the broad data examples in the demonstration prototype were initially derived by the primary researcher, and based on general presumptions and knowledge obtained during the investigative part of the research. These ratings were subsequently sent to the research project’s collaborator, the Operations Manager for the Centre of Excellence at WPNP, who then rated the more detailed data sources to which the demonstration prototype would give access, based on their professional judgement. For the purpose of the research project, this represented the formal rating required for a confidence rating system (described earlier in section 5.6.3). Although only the alternative data were rated for the demonstration prototype, it would seem feasible that traditional data could be rated in a similar fashion, particularly with regards to
usefulness. As the previous Figure 5.44 showed, a colour scheme was already designed to support such a rating.

The demonstration prototype divides data into 10 categories – five each for traditional data and alternative data – that are broadly based on the data source attribute. The theoretical confidence ratings system described in section 5.6.3 regarded the data source as a key indicator for potential data quality and usefulness, and listed eight possible data sources. For the purpose of the demonstration prototype, these initial data source classes identified were reassessed and renamed to create five categories that housed the previous eight classes. The categories ‘Special interest / community groups’ and ‘Social media sites with or without associations or credentials’ for example, were all regarded to essentially be collaborative, social media sites and were thus combined under the new category ‘Social Media’. Using the broader term ‘organisations’ meant that the previous categories ‘Businesses’ and ‘Not for profit/volunteer organisations’ could also be combined. And finally, the new ‘References’ category would be able to incorporate data sources such as online journal repositories, catalogues of libraries and museums, as well as any academic digital archives. The five resulting categories for alternative data were thus Organisations, Reference, Government, Media and Social Media.

This arrangement of data classes was for both usability and practical reasons. Having fewer data categories was regarded to improve usability by reducing the number of choices that users would have to consider. Combining various sources into one category, such as Organisations, would further provide a greater number of results more easily and instantly, which could be filtered using other data attributes instead. The practical aspect had to do with fitting the application on one screen. Five categories of traditional and non-traditional each data provided a better visual display and manageable blocks. For example, the blocks were big enough to fit text with a font size that was legible. Nonetheless, if Parks Victoria were to choose to categorise its data differently resulting in a larger number of classes, the treemap design applied may have to be re-evaluated so as to not only fit on the screen and be legible, but also to be usable and effective.

Parks Victoria data can be classified in various ways. For the purpose of the demonstration prototype, to match the alternative data, they were classified based on data source or origin. Four data source categories seemed obvious: Corporate, DSE,
Legislation and Local, with a fifth, Partners, added to represent most of the remaining data that did not fit into the first four categories. For example, data from Parks Canada or Parks Forum, of which Parks Victoria is a member, fell into this category.

Finally, the demonstration prototype used static maps at various scales, obtained as screenshots from Microsoft’s Bing Maps, the default Web mapping system at Parks Victoria. Users therefore could not select a geographic area of their choice as the various zoom levels and associated maps were predefined by the prototype. This was due to technical limitations. It was envisaged however that an actual GKT would either incorporate a live mapping system like Bing Maps or Google Maps, or else it could draw on Parks Victoria’s existing ParkView mapping system or GIS data.

5.7.5 How a geo-knowledge tool could work

The demonstration prototype partly aimed to replicate how a GKT would function. Some of these proposed functions were represented by interactive components, whereas others parts were symbolised using passive buttons or tabs that aimed to demonstrate the possibilities of such a tool. The prototype had two areas, identified as 'Search' and 'Work Area'. Users would search for data in the former and interact with data they had selected in the latter. Appendices XI and XII show overviews of both areas with detailed descriptions of all tabs, buttons and other areas. A broad summary of how a GKT could work based on the demonstration prototype is described below.

5.7.5.1 User interactions in Search

Search is essentially the home page, and is the interface shown in Error! Reference source not found.. Search comprises four basic tools for users to refine data. Users would be able to:

1. Type in or select one or more keywords;
2. Select a geographic area using available buttons or by drawing an area on the map;
3. Select the data sources they wished to be included by selecting appropriate individual tabs (or use the 'Select all' button); and
4. Set the slider to select the desired confidence rating.
These four tools were located in the two grey/white banners directly above and below the map (see Figure 5.46 – broadly indicated by red numbers 1 to 4), and positioned in the top half of the screen to make them easily accessible.

Figure 5.46 - Top half of demonstration prototype interface design.

Users would need to type one or more keywords, however, applying an auto-completion system with keyword options appearing as users start typing would enhance this task and the refinement process.

Geographic areas could be selected from either one of five tabs that were regarded to represent four geographic levels at Parks Victoria: a park, district, region and Parks Victoria as a whole with a free format option to type in any other geographic attribute such as a location within a park or a bioregion. Alternatively, a geographic area could be selected using a drawing tool to draw an area on the map.

Setting the confidence rating slider to a particular rating would mean only results with that rating or higher would be presented.

In a working GKT, any one action would update results automatically. Any of the tasks would be able to be completed in any order and multiple times at any stage for data results to be continuously refined and updated.

In the Search area, users would be able to interact with data, represented by the blocks, in various ways. They could hover over data blocks to obtain a more detailed description. This would simultaneously highlight the geographic attributes on the map above (see Figure 5.46 where the red square and circle in the map area represent the geographic locations attached to the highlighted data block). Users would also be able
to double click on a block to open documents or sites, or blocks could be selected to interact with at a later stage. Selected data blocks would remain selected even after the results were further refined. Alternatively, selected data blocks could be saved in 'My Folder' – regarded as the location for permanently saving selected data as well as any personalised or annotated data using the tools that are part of the Work Area. In a working GKT, any of these data interactions would be available at any time. The demonstration prototype, due to technical constraints, only allowed one type of interaction at any one time. A step-by-step guide was therefore developed to assist users of the demonstration prototype (see later section 5.7.6 for more details on the review).

The smaller maps to the right of the map area (see Figure 5.46) would be a quick means to go back and forth to zoom areas users had already visited (and thus to the associated data results). If no keywords or geographic area were selected, the tool would show only broad results – for example the IUCN website rather than a particular article found on the site. The system could be set up so it would know the user’s physical location through the computer’s IP address and therefore already show data related to that location. However, as people may not be after local data, using one’s location could be a user setting they could choose.

Theoretically, data would be appropriate to the geographical scale applied. This would be reliant on the classification and particularly the levels of geotagging applied to the data. For example, a corporate policy document can also apply to a local park. Hence, data would need to be tagged at all applicable geographical levels so the data appear at different zoom levels. The tool’s ability to select data at any time and save that data even if further search refinements are made, means users could choose data applicable to different geographical levels as they zoom in or out. For users that immediately select their geographic area of interest however, the multiple geotags representing different geographic scales would be beneficial.

The Work Area and My Folder buttons (located at the top left – see Figure 5.46) would allow navigation to those locations respectively. The Settings button would allow users to change the settings of their tool, such as the aforementioned option for the system to recognise the physical location of the user. Additional settings options envisaged for the GKT include the ability to change colour scheme and to change the number of data items visible in the results (the current design shows five items for each category with
the sixth block clickable for more results). A maximum number of visible data blocks may be required, based on legibility on the screen. Other potential settings considered were the positioning of personal and user tools (currently in the Work Area, see ensuing section and Figure 5.47), and a choice to view the small maps on the right of the main map, or as tabs at the bottom of the map. The function of the Help and Exit buttons are regarded to be self-explanatory.

5.7.5.2 The Work Area

Although data blocks could be opened for further inspection at any point in the Search area, data blocks that the user selects could be interacted with in the Work Area (see Figure 5.47). This is the point at which the layout changes and the screen becomes a new type of ‘geographer’s desktop’ – a “direct-manipulation user interface for map overlay” (Egenhofer and Richards 1993, p. 65). This geographer’s desktop, Egenhofer and Richards (1993) outlined, comprised selected geographic data that could be presented as a geographic overlay on a ‘viewing platform’. Users could apply a number of analysis methods to interact with the data, including map and tabular presentations, and statistical graphs. For the purpose of the GKT, the map overlay function was broadened somewhat, with the interface allowing for manipulation of georeferenced data using a variety of tools including an interactive map.

The screen of the Work Area part comprised a map area (top section) and a work area (bottom section). Like the Search area, users would be able to enlarge or reduce either one as desired by dragging the central line that split the two areas. The results that the user would have selected previously showed in a column on the left, and could be dragged onto the work area to interact with (see Figure 5.48). Users would be able to open them with multiple data viewable at the same time (see Figure 5.49).

Like in the Search area, the main map area would indicate the geographic area that the selected data covers, with multiple locations highlighted if applicable. The smaller inset maps to the right of the main map area (see Figure 5.48) could be used to move between different geographical zoom levels that apply to the data, or that the user had already visited. Data relevant to that zoom level would subsequently be ‘highlighted’, to make the user aware they are relevant to the geographic location. Clicking on an inset map would enlarge it, and reduce the current main map screen to an inset map instead.
Alternatively, it is envisaged that users should be able to control the size and location of these maps, as they may wish to view multiple maps at once side by side.

Figure 5.47 - The Work Area of the proposed GKT.
Figure 5.48 - Selected data can be dragged onto the work area for interaction.

Figure 5.49 - Viewing multiple documents in the Work Area for interaction.
Suggested personal user tools include the ability to annotate, zoom and search as well as a notepad and the ability to save data permanently in My Folder. Data maintenance tools would also be available at this stage that would allow users to add keywords, comments and confidence rating to data for other users to consider. As aforementioned, the confidence rating system was regarded to be an evolving system that, apart from a formal rating provided by Parks Victoria, would rely on users to add ratings and opinions with regards to quality and usefulness and anything else deemed to be relevant.

Both sets of tools were designed as buttons with dropdown menus (see Figure 5.47 for the dropdown menu for the data maintenance tools). It was simultaneously envisaged that the tools would be positioned on the actual data. Two data items were altered to demonstrate how such tools could become part of individual documents for easy use. The top document (with the clear Four Corners line) shown in Figure 5.49 is such an altered file. The top left part shows potential user options including the confidence rating applicable to the document.

5.7.5.3 Other considerations

Various other issues were considered with regard to the design of the demonstration prototype, and how a GKT could function. For example, users may be required to sign in to be able to save data permanently in My Folder. The same sign in option could also be applied to present only data that are relevant to the user – staff and members of the general public would have access to different data for example.

The demonstration prototype also does not really show how data that are linked can be represented – the non-sequential connections described by Ted Nelson (1992) and cumulating in his hypertext (see Chapter 3.3.2). The data displayed in the demonstration prototype were linked by keywords, but other keywords would also have been attached to the data. If these additional keywords were made visible, users could change their search path by selecting or clicking these keywords instead. Perhaps a simple option to ‘view other attached keywords’ could make this consideration feasible.

Finally, it should be taken into consideration that the research project did not develop any technical solutions as to the development of a GKT, nor did it ever consider if the proposed functionalities actually exist or could be designed. For example, it is not know if it would be technically possible for users to annotate a website in the manner
envisaged, or if it would be restricted to the abilities of, for instance, the browser used. As aforementioned already, any technical solutions were outside the scope of the research project.

5.7.5.4 Limitations of the design and demonstration prototype

It should be understood that the design chosen for the interface carried with it restrictions. Because the primary aim of the demonstration prototype was to demonstrate a concept, it was not required to be a fully operational tool with full data access, functionality and user options. Although the interface design process was comprehensive and took up a significant amount of time, it ultimately was about the amalgamation of two data sources – traditional and alternative – and if they could be combined in an effective GKT. The interface design tried to incorporate a range of features and considerations, some in active form but most through a passive presence. If a GKT was to be built, the interface would likely have to be redesigned to allow for the incorporation of all features, options and tools that were required.

The demonstration prototype allowed its reviewers to interact with it within its limited capability. For example, the prototype used predefined keywords, geographical areas, maps and data that the user could select, without the user having any choice. Other tools and parts were non-interactive but were added as a means to inform the reviewer that such features formed part of the conceptual GKT. It was ensured that there was a variety of traditional and – carefully selected – non-traditional data related to the use scenario that the user could view. Together with an accompanying user guide that further explained what the demonstration prototype could do versus a fully developed tool, people reviewing the tool were regarded to be better able to form an opinion of the possibilities offered by a GKT and if the amalgamation of traditional and alternative data sources could be useful.

5.7.6 Review of the demonstration prototype

After completing the demonstration prototype, it needed to be reviewed by relevant stakeholders. The purpose of the demonstration prototype was to demonstrate a concept and to assess the theories being applied. The research’s two main objectives were to provide access to traditional and non-traditional data, and assess if access to the latter could potentially benefit the former. The demonstration prototype comprised both types of data, giving users the opportunity to form an opinion on the potential usefulness of having access to both traditional and non-traditional data sources.
Six people with varying expertise in cartographic design and usability gave informal assessments as to the overall design of the demonstration prototype. This occurred both during the design process and after completion of the demonstration prototype. In addition, Parks Victoria being a collaborator on the research project, 12 Parks Victoria staff members and one DSE employee reviewed the demonstration prototype after its completion. They were being asked to consider the overarching theories whilst their opinion on the design and usability was simultaneously sought. The feedback received from both groups of reviewers would be considered for potential amendments to the demonstration prototype, and would be the base for recommendations for the building of an actual GKT.

5.7.6.1 Feedback on overall design and usability

The six people who looked at the demonstration prototype and discussed the overall design and interface during the design and afterwards comprised four members of the Affective Atlas team, a Parks Victoria staff member and a professional cartographer indirectly connected to the research project. The reviewers collectively had expertise in a number of relevant areas including cartographic design, user centred design and new media (see Table 5.9).

<table>
<thead>
<tr>
<th>Reviewer</th>
<th>Area of expertise</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewer 1</td>
<td>Cartography and Geovisualisation</td>
<td>Affective Atlas</td>
</tr>
<tr>
<td>Reviewer 2</td>
<td>Interaction and Interface design</td>
<td>Affective Atlas</td>
</tr>
<tr>
<td>Reviewer 3</td>
<td>Interaction and User Centred design</td>
<td>Affective Atlas</td>
</tr>
<tr>
<td>Reviewer 4</td>
<td>New Media</td>
<td>Affective Atlas</td>
</tr>
<tr>
<td>Reviewer 5</td>
<td>Cartography, Web design, GIS</td>
<td>Parks Victoria</td>
</tr>
<tr>
<td>Reviewer 6</td>
<td>Cartography</td>
<td>External</td>
</tr>
</tbody>
</table>

Table 5.9 - Areas of expertise of reviewers and their affiliation.

Feedback during the design process was obtained via an informal group discussion and individual face-to-face meetings. After completion of the demonstration prototype, individual, informal discussions were held with four of the reviewers. The prototype was demonstrated and the various components were explained during these sessions, after which the reviewers verbally provided their thoughts on the general design and/or
usability of the demonstration prototype. The feedback received was generally positive, and the overall design was generally liked. A number of comments were regarded to be particularly useful for any amendments to the demonstration prototype or else as potential design considerations for a future GKT.

Feedback on the colours used for the data blocks was regarded as the most pertinent. Despite efforts to create a colour scheme that was suitable for colour-blind people, one reviewer regarded the range colours for the data blocks as being too similar. Although it was possible to differentiate between colours that were positioned next to each other, some of the green colours that were further apart were not distinct enough in the reviewer’s opinion. It was further difficult to differentiate between the various yellow shades, whilst the use of two yellow colours was not seen as optimal either. It was suggested that it should be more important that people can differentiate between colours than to stick with the green and yellow-red schemes. It was suggested to add blue and purple colours to the colour scheme, or else take the colours of the rainbow and add colours in between (to get up to 10 colours). It was further suggested to ensure these colours would not be too bright. This latter solution is somewhat similar to the Munsell colour system already tried (see previous Figure 5.43), although the colours applied in this figure are perhaps brighter than is desirable. The reviewer suggested a number of references for further research on choosing colours if changes to the colour scheme were to be considered.

A number of comments related to the use of contemporary Web elements. For example, the confidence ratings could be shown using a five star rating system, similar to other websites with rated content, whilst a tag cloud could be applied to visualise popular keywords being used. Both suggestions would require redesigning the interface to allow for such features to be incorporated.

With regards to usability of the demonstration prototype, one reviewer suggested that it should be made very clear to reviewers what parts of the demonstration prototype are interactive as most people do not like to follow step-by-step instructions but instead want to explore without reading any such instructions. The use of red and black symbols to show interactive components was regarded by other reviewers as sufficient for making this clear.
A final point made by one reviewer questioned, or clarified, the primary capability of the GKT. The tool had thus far been presented as a means to ‘access’ data. It was suggested that the tool is perhaps more accurately a means to ‘find’ data instead. For example, GIS data once presented in the GKT would need to be accessed in a GIS system rather than through the tool. It is unclear if technical solutions could provide actual access, for instance by creating a link that would take the user directly to the GIS system and open the data in said system. This would effectively mean that the GKT did provide access to the data. According to the Microsoft’s *Encarta* dictionary\(^{115}\), access can mean to “get information – to have the opportunity or right to experience or make use of something” and to “call up data – to retrieve data…“. These two meanings of access arguably can encompass ‘finding’ data, and the primary capability of the tool can therefore remain as providing access to data.

Nonetheless, it was regarded as useful to reassess and reconfirm the GKT’s purpose. This was, at its core, to provide enhanced access to a broad range of digital georeferenced data, including Parks Victoria’s existing data and data found on the Web. The primary notion was that it would assist users in finding useful, appropriate data by firstly opening up the vast collection of organisational data, and complementing these with potentially relevant, additional data available from public resources. Relevance was indicated through the use of thematic and geographic keywords. The GKT was envisaged to be the central information system for users to find any data potentially relevant to their needs, without the need to consult different databases or information systems, or having to search the Web. The essence therefore was regarded to be that it was one system through which all (or a broad range of) data could be found or accessed; data would become available for the user to apply.

### 5.7.6.2 Stakeholders’ review

A number of stakeholders took part in a more formal review of the demonstration prototype. This comprised face-to-face discussions and a request for written feedback using a feedback form. The form asked four broad questions and had a free format section to write down thoughts and comments. It was envisaged that using a feedback form would formalise the note taking and assist the analysis of the qualitative responses. The feedback form was accompanied by a step-by-step guide that aimed to guide reviewers through the demonstration prototype. The guide pointed out the active and

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\(^{115}\)This dictionary is available as a review tool in Microsoft *Word* software.
passive elements, and worked through all relevant features and aspects. Appendices XIII and XIV show a copy of the feedback form and step-by-step guide respectively.

Recruitment process

In order to find suitable people to review the demonstration prototype, the main collaborator on the research project at WPNP and the key contact at Parks Victoria Head Office were asked to recommend people. After completing the review themselves, they were able to suggest people who might be able, and, perhaps more importantly, willing, to assist. Initially, people with knowledge of the research project’s background or ecological fire management at WPNP were deemed the most suitable. However, it became obvious that this would result in a limited choice of people, and after several people from this group declined to participate, the view as to who could review the prototype was broadened. Broadly, the underlying theory behind the research project and the demonstration prototype – that Parks Victoria’s data are not used as effectively as they could – was understood by most staff. Additionally, the demonstration prototype was developed in such a way that in order to review it, knowledge of ecological fire management or of WPNP was not regarded as being essential. It was thus suggested that potential reviewers should have knowledge or insight into one aspect at a minimum: they could be linked to WPNP, fire management, ecological management, or knowledge/information management, whilst the group of reviewers as a whole should cover all aspects. Ideally, the group should also cover different roles and management levels including those involved with WPNP in order to try and obtain a range of perspectives. This approach is considered to be in line with what Marshall (1996, p. 523) calls a “judgement sample… [or] purposeful sample”. The researcher chooses the most useful sample that can test the theory, based on a “framework of variables that might influence an individual's contribution” (Marshall 1996, p. 523).

A total of 23 people were contacted, with 10 declining or not responding to the invitation to participate thus leaving a positive response rate of 56%. The roles of the initial 23 people comprised managers, team leaders, program officers and program coordinators, rangers, and other officers and coordinators. Of this group of 23, senior staff directly connected to WPNP included the Ranger in Charge, a senior park ranger in natural values, and the District Program Manager. Between them, the group covered the key topics of fire management, ecological fire management and ecological and environmental management in general, as well as knowledge management.
**Final group of reviewers**

The remaining 13 that responded positively and agreed to take part in the review comprised 12 Parks Victoria staff members and one DSE employee. The group as a whole possesses knowledge of or insight into the aspects identified, either due to current or past roles or activities. Most link to multiple aspects, and all were aware of the underlying theory that data at Parks Victoria are not used as effectively as they potentially could be. The reviewers covered a number of roles, whilst their geographical location and direct connection to WPNP – either through their current or past position – varied. Tables 5.10, 5.11 and 5.12 show the different divisions and characteristics identified in the final group of 13 reviewers.

<table>
<thead>
<tr>
<th>Key topic</th>
<th>Number of reviewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPNP</td>
<td>Five</td>
</tr>
<tr>
<td>Fire management</td>
<td>Six</td>
</tr>
<tr>
<td>Ecology / environment</td>
<td>Five</td>
</tr>
<tr>
<td>Knowledge management</td>
<td>Two&lt;sup&gt;116&lt;/sup&gt;</td>
</tr>
<tr>
<td>Knowledge in other areas&lt;sup&gt;117&lt;/sup&gt;</td>
<td>Four</td>
</tr>
</tbody>
</table>

Table 5.10 - Division by key topics encapsulating the demonstration prototype

<table>
<thead>
<tr>
<th>Current role</th>
<th>Number of reviewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager</td>
<td>Three</td>
</tr>
<tr>
<td>Team leader / Senior officer</td>
<td>Two</td>
</tr>
<tr>
<td>Scientist</td>
<td>One</td>
</tr>
<tr>
<td>Fire officer</td>
<td>Two</td>
</tr>
<tr>
<td>Environmental officer</td>
<td>Three&lt;sup&gt;118&lt;/sup&gt;</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Three</td>
</tr>
</tbody>
</table>

Table 5.11 - Division by role, based on their current employment.

<sup>116</sup> One of these reviewers was the former Knowledge Management Team Leader. As aforementioned, Parks Victoria has changed focus from ‘knowledge management’ to ‘information management’. Current staff involved in information management who were contacted declined to participate.

<sup>117</sup> This knowledge in other areas is based on the reviewers’ current job titles. The three areas identified are visitor services, communication, business coordination and recovery.

<sup>118</sup> The total sum of this table is 14, because one reviewer was both a fire office and an environmental officer and is hence counted twice.
### User centred geo-design considerations

For the purpose of the demonstration prototype, primarily because of its focus on appropriate data as well as its relatively limited capabilities, the focus when choosing reviewers was on stakeholders’ knowledge of the main broad topics (as listed above). However, if a more advanced or expanded prototype – or an actual GKT – was developed, an additional user centred design approach would have to be considered that focuses on “use, users, and usability of… hardware, software and information systems, interfaces, geographic data and databases” (Van Elzakker et al. 2008, p. 84). The proposed GKT is a collaborative, geographically oriented information system that allows users to find, share and contribute data. Research has shown that the design of such a tool should allow for different ‘sociotechnical’ or user issues, as else it is likely that users will not accept it (MacEachren 2005; Yovcheva, van Elzakker and Köbben (In press)). As aforementioned in section 4.5.2, the characteristics of some Parks Victoria’s field staff means they are likely to be more averse to new technology so these constraints have to be taken into consideration. Other user centred design research focusing on the application of geospatial data in a web-based environment (e.g. Yovcheva, van Elzakker and Köbben (In press)) or for mobile devices (e.g. van Elzakker and Delikostidis 2010) should be considered, the latter particularly if a GKT was expanded to also be accessible on such devices for staff in the field to access data.

### Validity of sample size

Because the review was qualitative in nature – the questions asked on the feedback form asked people’s opinion on issues, and the research was not looking for statistics – 13 reviewers was regarded as an adequate number. Qualitative research does not follow set

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<table>
<thead>
<tr>
<th>Location</th>
<th>Direct involvement with WPNP</th>
<th>Number of reviewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPNP / Foster 119</td>
<td>Yes</td>
<td>Five</td>
</tr>
<tr>
<td>Parks Victoria Head Office</td>
<td>Partly (corporate)</td>
<td>Five</td>
</tr>
<tr>
<td>Other regional offices</td>
<td>No</td>
<td>Three</td>
</tr>
</tbody>
</table>

Table 5.12 - Division by reviewer location, and direct involvement with WPNP, either at present or through previous positions.

---

119 Foster is the regional office for WPNP, and both Parks Victoria and DSE staff based here are directly involved in WPNP management and in particular fire management and fire planning.
rules when it comes to sample size (Patton 2002). Instead, it depends on whether the research’s scope requires breadth or depth: is it useful to have a limited range of viewpoints from a lot of people or the broader opinions of only a few people. This in turn can be dependent on a number of factors that include the usefulness of the information obtained and the resources available. According to Hackos and Redish (1998), small sample sizes of around six to eight people will discover most design issues between them. Nielsen (2000) and Virzi (1992) argue that a group of five is often sufficient for usability testing, although others disagree and challenge the statistical formula applied to arrive at this figure (e.g. Spool and Schroeder 2001; Woolrych and Cockton 2001). Faulkner (2003) states that although a group of five people in some instance may find 99% of the problems, in other instances they found only 55% of problems. When the sample size was increased from five to 10 and 20, the lowest percentage of problems found increased to 80% and 95% respectively. A qualitative study conducted by Marshall (1996) more or less concurred and determined that no new information was obtained once 15 people were interviewed. Considering these views and the qualitative notion of the research without a need for statistical rigour, the sample size of 13, essentially determined by the recruitment process followed and the associated resources made available, was deemed to be acceptable.

Stakeholders’ review sessions
The review sessions with the stakeholders comprised face-to-face discussions. There was one group session with three reviewers, whilst the rest of the discussions were conducted one on one. Two sessions, including the group one, took place in a meeting room, eight were conducted at people’s work desks whilst one took place in the courtyard of a hotel. In all sessions, the primary researcher firstly outlined the background theories before showing the demonstration prototype to the stakeholders and explaining how the tool worked. After this, the reviewers were invited to use the demonstration prototype themselves, whilst the researcher took notes on the ensuing discussion and commentary. Eight reviewers choose to complete the feedback form during or immediately after the discussions, whereas the remaining five opted to take the form and a copy of the demonstration prototype for later perusal. This allowed them to view the prototype again and complete the form in their own time. A time was agreed upon for this to be completed, to ensure the feedback was returned in a timely manner.

120 The reviewer was in Melbourne for an unrelated meeting, and the time and location of the review session was the most appropriate to the reviewer’s schedule.
The combination of the comments written on the feedback form and the comments noted down by the researcher during discussions were deemed very useful, as it became apparent that some reviewers said a lot more than they wrote down. By combining the two sets of comments, it was possible to obtain a fuller picture.

Bearing in mind the attitude of some reviewers, in some instances the questions on the feedback form were used to open up or guide (part of) the discussion. Some reviewers, one with perceived prior knowledge of the research, appeared keen to discuss the research and underlying questions without much considering the demonstration prototype itself. For these reasons, apart from being a means to formalise the note taking, using a feedback form was regarded as a useful means to obtain relevant information to assist the analysis of the qualitative responses.

An analysis of the reviewers’ comments and feedback is discussed in Chapter 6 – Analysis and Discussion. This is because the feedback was regarded to be at the core of the research project and its primary objective, and would inform and assist the researcher in trying to answer the research questions.

### 5.8 Chapter summary

The purpose of this chapter was to describe the case study component of the research project. After the investigative phase, this was the implementation phase of the research and comprised two main parts: the preliminary activities, and the development of the conceptual GKT and demonstration prototype.

The chapter firstly introduced aspects of the case study that included its focus areas of WPNP and fire management, and the main phases. It then discussed the first preliminary activity that comprised an investigation in fire management, the decision process and data requirements. This revealed a cascading framework from legislative, government and corporate requirements and policies, to regional and district documents and guidelines, to data requirements at a local park level. How these data are accessed at Parks Victoria and WPNP, and what agencies or stakeholders are consulted were also described, and produced a generalised overview of the data requirements and decision process for a planned ecological burn at WPNP.
The next section discussed non-traditional data sources that the GKT could draw on. It firstly focussed on such data available on the Web and applicable to the case study. The potentially relevant content of a number of digital data archives was checked using a number of keywords that include fire ecology, fire management, park management and planned burning. The results showed that alternative data available on the Web are potentially relevant to Parks Victoria, however, without a means to assess the potentially quality and usefulness of these data, it would be difficult to ascertain if they can benefit the organisation’s traditional data.

Park visitors were regarded as another alternative data resource. In line with Web 2.0 and crowdsourcing concepts, a park visitor survey was conducted at WPNP to assess visitors’ thoughts on Web 2.0 and their potential willingness to participate and contribute information. The primary outcome of the survey revealed that about two thirds of park visitors would potentially contribute information if they were asked to do so by park managers, provided there was a specific task or purpose involved. This would mean that if managers at Parks Victoria or WPNP require certain information that park visitors can assist in collecting or contributing, a special crowdsourcing project could potentially be successful. Such a project could ask visitors to participate during their stay in the park, or through appropriate collaborative Web tools that visitors are already using for their own personal needs.

Bearing in mind the findings of these investigations, the case study could then move on to a conceptual model of the GKT. This comprised two mind maps that showed four main components – data in, users, functionality, and data out – as well as various linkages between different aspects and issues encountered. The four main components were described in detail, whilst two issues associated with the functioning of a GKT were expanded upon in the following section. These two issues related to the quality of alternative data and variation in georeferencing of data that exist. A theoretical methodology for a confidence rating system was described. The system uses a number of data attributes that could provide indicators as to what data quality and usefulness users are likely to expect. Although the ambiguity in defining ‘quality’ and ‘usefulness’ was acknowledged, the system was regarded as evolving and could become more effective over time as users would add their own rating and comments as to the quality and usefulness of data. To address the issue of variation in georeferencing, the research project proposed a geographical framework. This framework would have a ‘formal’
component to accommodate a wide range of existing, traditional or official geographic attributes whilst an ‘informal’ or dynamic component would allow for the alternative and personalised geographic information found in UCI and other digital data. By linking these alternative data in turn to the formal component of the framework, a GKT would be able to present all data relevant to a particular location.

The final part of the chapter discussed the development of the demonstration prototype. It described the overall design process commencing with the proposed use scenario and data needs. A preliminary activity investigated the data requirements for a planned, ecological burn at WPNP. The findings assisted in determining to what data the demonstration prototype should provide access. The final dataset comprised a selection of traditional data from the various levels of fire management combined with a number of alternative data sources including local data not traditionally widely accessible and Web resources.

Once a dataset was developed, the design and development of the actual demonstration prototype could commence. The next section thus outlined the design process from early design ideas on paper to the final, interactive demonstration prototype developed with Macromedia’s Flash software. It then explained how such a tool would work. A Search area would allow users to find relevant data with four options available to refine search results: keywords, geographic attributes, alternative data sources to be included, and the minimum level of confidence rating required. The Work Area of the tool would allow users to interact with data they had selected.

Upon completion of the demonstration prototype, four people with varying expertise in cartographic design and usability reviewed the overall design and usability of the prototype. Feedback received would be taken into consideration for any redesign of the prototype or an actual GKT. Following these reviews, the primary researcher held informal sessions with 13 stakeholders from Parks Victoria and DSE. They were asked to review the demonstration prototype bearing in mind the background theories, and simultaneously gave their thoughts on the design and usability. Because the results were regarded to be at the core of the research project, and would assist the researcher in answering key questions, an analysis on the feedback received was to be described in the next chapter.
This chapter has described the case study component of the research project. The next Chapter 6 – Analysis and Discussion – firstly discusses the results of the stakeholders’ review of the demonstration prototype, and provides an analysis of what these mean. It then reviews the findings in relation to a conceptual and future GKT. Drawing in findings from other chapters and sections where appropriate, the final section discusses the primary aims of the research project, and addresses the four research questions posed.
Chapter 6. Analysis and Discussion
6.1 Chapter overview

The primary objective of the research project was to enhance access to and utilisation of a digital data archive – with Parks Victoria's existing data archive applied to the research. To achieve the objective, a theoretical methodology for a GKT as a means to access the inherently georeferenced data was developed. The research project asked if applying concepts of emergent Web developments could contribute to the effectiveness of a GKT. The focus was particularly on the participatory and collaborative aspect of Web 2.0, which allows people to contribute information using participatory tools where they traditionally may not have. Some argue that the information contributed by these non-traditional data providers can benefit existing data. The research project broadened the Web 2.0 concept of information contributed by users (UCI) to include any data available on the Web. The GKT would thus provide access to Parks Victoria’s existing data as well as additional data sources not traditionally relied upon by the organisation, and it would assess if these alternative data sources could potentially complement the organisation's existing data archive.

To address the ‘geo’ aspect, the research project also considered Web developments in the geospatial realm for the methodology for a GKT. These include the emergence of Web based mapping tools to visualise georeferenced information in different ways.

The purpose of this chapter is to provide an analysis and discussion on the findings of the research, and address these in relation to the research project’s objectives. The chapter firstly provides an analysis of the reviewers' comments on the demonstration prototype and the underlying theories. The feedback was regarded to be at the core of the research project as the GKT represented by the demonstration prototype was developed to address the primary objective. The analysis outlines the written feedback obtained through feedback forms, with verbal comments added to appropriate sections. This is followed by a discussion on how various issues identified relate to the conceptual model or a future GKT. The final section discusses all findings, including relevant findings from other chapters and sections, by answering the research questions that encapsulate the primary objectives.
6.2 Analysis of demonstration prototype feedback

Thirteen reviewers of the demonstration prototype provided verbal feedback during informal discussions as well as written comments through the feedback form. Table 6.1 shows the profiles of the thirteen reviewers using the key characteristics outlined previously in Chapter 5.7.6.

<table>
<thead>
<tr>
<th>Current role</th>
<th>Area of expertise*</th>
<th>Direct involvement with WPNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Operations Manager</td>
<td>WPNP, FM, KM</td>
<td>Yes</td>
</tr>
<tr>
<td>#2 Environment Research Officer</td>
<td>E</td>
<td>Indirect</td>
</tr>
<tr>
<td>#3 Environment Scientist</td>
<td>E</td>
<td>Indirect</td>
</tr>
<tr>
<td>#4 Fire Management Officer</td>
<td>WPNP, FM</td>
<td>Yes</td>
</tr>
<tr>
<td>#5 Fire Program Coordinator</td>
<td>FM</td>
<td>No</td>
</tr>
<tr>
<td>#6 Fire &amp; Environment Program Officer</td>
<td>FM, E</td>
<td>No</td>
</tr>
<tr>
<td>#7 Environment Project Officer</td>
<td>E</td>
<td>Indirect</td>
</tr>
<tr>
<td>#8 Team Leader Research Coordination</td>
<td>E</td>
<td>Indirect</td>
</tr>
<tr>
<td>#9 Senior Communications Officer</td>
<td>FM, O</td>
<td>No</td>
</tr>
<tr>
<td>#10 Business Coordination Manager</td>
<td>KM**, O</td>
<td>Indirect</td>
</tr>
<tr>
<td>#11 Visitor Servicers Coordinator</td>
<td>WPNP, O</td>
<td>Yes</td>
</tr>
<tr>
<td>#12 Recovery Values Coordinator</td>
<td>WPNP, O</td>
<td>Yes**</td>
</tr>
<tr>
<td>#13 District Program Manager</td>
<td>WPNP, FM</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 6.1 - Profiles of the reviewers of the demonstration prototype.

*Area of expertise relates to key topics identified as relevant to the demonstration prototype as discussed in Chapter 5.7.6. These are WPNP, fire management (FM), ecology / environment (E), knowledge management (KM) or other areas (O).

** Indicates in former role.

The feedback form (see Appendix XIII) that reviewers were asked to complete comprised five questions. These five questions, renamed questions A through to E in the ensuing sections, were as follows:
Question A: Can you please write down as many comments and thoughts you may have with regards to the following key questions? Although you have only worked with a demonstration prototype with limited capabilities and access to selected data, please try and consider these based on your understanding of an actual, fully operational geo-knowledge tool.

1. Is the tool a means to make better use of Parks Victoria’s data? Consider:
   - All data in one tool
   - Use of keywords and geographic attributes to find relevant data

2. Is the combination of Parks Victoria data with alternative data in one tool potentially useful?

3. Could the additional information potentially complement or benefit Park Victoria’s existing data??

Question B: Can you see a purpose for such a tool for some of your activities? If yes, can you give an example of a use scenario or activity?

Question C: What do you think of the overall design of the tool?

Question D: What do you think of the overall usability or ‘ease of use’ of the tool?

Question E: Do you have any suggestions for changes to the tool that would improve it or make it more usable in your opinion? You can use the box below or the attached sheet with copies of the two main screens to point out or mark specific items of the tool more easily.

Questions A and E generally attracted the most comments, whilst question B was often already at least partly answered in question A. Some of the responses to questions C and D were very similar or overlapped, and the feedback for these two questions has therefore been combined into one section for the purpose of this chapter.

The following sections describe the comments received for individual questions on the feedback form, preceded by the actual question. Additional verbal comments obtained from the face-to-face discussions have been added to sections as appropriate.
6.2.1 Comments in response to question A

Question A:

*Can you please write down as many comments and thoughts you may have concerning the following key questions? Although you have only worked with a demonstration prototype with limited capabilities and access to selected data, please try to consider these based on your understanding of an actual, fully operational geo-knowledge tool*

1. *Is the tool a means to make better use of Parks Victoria’s data? Consider:*
   - All data in one tool
   - Use of keywords and geographic attributes to find relevant data

2. *Is the combination of Parks Victoria data with alternative data in one tool potentially useful?*

3. *Could the additional information potentially complement or benefit Park Victoria’s existing data??*

Considering the three questions inherent in the above question A, the feedback received covered similar themes to those found in the questions. A number of comments concerned the concept of the tool in relation to Parks Victoria’s data. Six people pointed out that it would be good to have one point of truth, or one tool that provides access to all available data. One reviewer expanded the data to all Parks Victoria’s resources, essentially regarding the tool as having the potential to becoming a ‘one-stop-shop’ for all Parks Victoria’s systems and data. Having everything in one place was regarded as a significant improvement over current systems and would eliminate the need to search different locations and systems individually. Additionally, making local data available in this way would avoid duplication of effort and reduce cost of having to produce data multiple times.

All reviewers indicated that the tool was potentially useful to access or retrieve data, with three mentioning they thought it was a potentially better way to specifically access and utilise Parks Victoria data. A benefit of the tool was regarded to be being able to find out what is out there, which was viewed as a challenge in the current environment. Rather than look for something specific that you know exists, the tool would assist in finding out new information you did not know existed. Similarly, the tool had the potential for users to find out what issues exist in a particular area. It was envisaged that selecting a geographic area of interest would present all data related to that area. Once
relevant issues were discovered, the tool could then be used to find additional information related to those topics. The emphasis therefore for three reviewers was the ability to find out about previously unknown data. Whether the tool provided access to the actual data was less important. One reviewer thus summarised their vision of the tool as being useful for finding data, knowing that data exist and knowing how to obtain the data.

Eight people commented that they regarded the ability to use keywords to search as positive, whilst four mentioned the usefulness of the geographic search function. It seemed that reviewers who liked the ability to search using geographic attributes were people who use spatial tools like GIS in their daily work, or these reviewers worked in specific locations that require georeferenced data. Using geographic attributes was thus regarded as an easier way to search for data for a particular area of a park. The keyword and geographic search options were described as simple, easy, intuitive, sensible and useful, although the challenge for Parks Victoria to attach such tags and geotags and convert the organisation's data into a usable format was recognised by some. One reviewer saw maintenance issues with keywords, in that they relied on users to be updated and maintained. It was suggested to develop a keyword list to ensure a consistency in labelling data.

Associated with the search options were comments relating to the effectiveness of search results. Most regarded an efficient search mechanism as valuable and three mentioned their experience with poor search systems, including the apparent inadequate mechanism in place at Parks Victoria. The question was asked how specific or in-depth the keywords would be, implying the search results would only be as detailed as the keywords attached. It was also asked if the tool would know what species were appropriate to a particular parcel of land that was zoomed into. Referring particularly to alternative data, it was suggested that the data results needed to be limited. If just a large amount of data was presented, one reviewer commented, users might not use the tool. Parameters could be applied to limit results. Examples given were setting a publication year or being able to define journal papers only from the Reference tab. It was further suggested that searches should not just return data, but instead would take the user to a relevant section within data as applicable. A search for ‘Environment Protection and Biodiversity Conservation Act’ and ‘orchids’ would take one (the user) straight to 'orchid species' section in the Act rather than having to scroll through the Act to find it.
Another comment suggested being able to search using phrases, essentially referring to advanced search capabilities.

Several of the reviewers described how they thought the tool could be used at this point. Three responses mentioned the usefulness of the tool for decision-making, or that the ability to access a broad range of data, including non-traditional data, would be an attractive management tool that had the potential to cover all management functions of Parks Victoria. Others saw it as a useful means to access different types of traditional data they require, as well as collect and maintain such data. Three reviewers regarded DSE as a potential user of the tool since they own or maintain a fair proportion of data used by Parks Victoria staff, whilst two others recognised the potential collaborative aspect of the tool. Volunteers for instance, could use participatory social media tools to enter survey data (to be viewed and applied by Parks Victoria staff).

Regarding the provision of access to alternative data, most reviewers generally saw that ability as positive, with one describing the combination of internal and external data as a strong point of the demonstration prototype that should be considered in future Parks Victoria models. Having a single interface to access both organisational data and wider databases on the Web would be useful to complete a task and provided a full view of relevant data. The additional data were regarded to complement and benefit Parks Victoria’s data, whilst the readily accessible information could improve or streamline processes and systems. Similar to having access to all of Parks Victoria’s data in one tool, a perceived benefit here was also the ability to find potentially relevant data of which users were not previously aware. However, four suggested that access to alternative data would be more useful for certain positions or duties. Social media data were mentioned several times as being useful for communications and obtaining a snapshot of media issues or public opinion. Two reviewers thought that because of the nature of their data needs, they would have limited if any requirements for alternative data themselves. One mentioned the need for verifiable information only, thus discounting social media but accepting reference data, whilst another stated they used research documents only but then described how they regularly access a number of websites for such data. One reviewer saw a potential downside to having access to other data sources, in that it might ‘add noise’ to searches: the search results could be too much, or else could give results that were not relevant or useful. However, it was added
that the ability to limit searchers using parameters provided by the demonstration prototype was a good way to deal with this.

Comments made concerning the underlying theories referred to the 'dire state of Parks Victoria’s data storage and retrieval', as well as the need for 'serious investment' in making the data available. The current duplication of data was also mentioned, with data held at central and regional offices for example. The research project was thus regarded by one reviewer as 'an important efficiency and productivity initiative'.

Finally, several comments related more or less to issues or concerns reviewers had. One concern was that the process for users to attach metadata (that is, keywords, ratings and comments) should be quick and simple. The maintenance issue of data quality control and version control was also noted whilst one reviewer liked the confidence rating system applied by the tool to address the quality issue. Lastly, recognising the effort involved in digitising all Parks Victoria data, it was suggested to start with the more important, ‘high level’ data first rather than the specific details or else just providing digital records rather than digitising the actual data could generally be sufficient. However, such a solution would contradict the comments regarding the effectiveness of searching being dependent on the level or detail of the attributes and the apparent wish for search results to return detailed data associated with small areas.

**6.2.2 Comments in response to question B**

**Question B:**

*Can you see a purpose for such a tool for some of your activities? If yes, can you give an example of a use scenario or activity?*

In response to question B, not a single reviewer wrote that they did not see a purpose for the tool. Ranging from general to specific, one reviewer stated that to have a large portion (or even the most relevant) of information in one place would be a great productivity improvement measure. Another reviewer could not imagine a professional activity that they undertook where the tool would not be useful. Again, two comments were made concerning the tool being a single point of truth that could provide access to all data and systems. It could become a single interface or a portal that would streamline all systems and allow Parks Victoria staff to access data including personal email, financial and payroll systems for instance. One reviewer mentioned the need for
security settings for such a system to ensure only data appropriate to the user was provided, which was in line with the comments of a second person who envisaged that the system would know who you were, and thus only provide access to relevant data and systems.

The key activities or areas that the tool was regarded to be useful for were planning, background information, research and monitoring. For example, a GKT appeared a useful planning tool that could assist the planning processes at a range of scales and help prepare management plans. Two reviewers mentioned its use for fire management planning including the preparations of fire ecology assessments and development of fire plans. One reviewer stated that the FireWeb system contained relevant information but regarded the GKT as useful for additional information not found in FireWeb.

There were several other statements that the tool would be useful to find such additional or background information, particularly for areas they were not familiar with. It was also regarded to be useful to find out what research had been undertaken in parks and reserves, areas of a park, or for particular species, to subsequently write reports on those areas or topics. It was further proposed that the tool could be used for research in relation to community engagement.

Three reviewers regarded the tool as being potentially useful for environmental monitoring activities or designing monitoring programs. The tool could be used to find out existing information about assets, threats and past and current monitoring programs in vegetation condition or fauna surveys. This is essentially using the local data of parks or staff that have conducted research and monitored species in their area. As one reviewer commented, these data are currently held in the work centre office where the research took place, and being able to easily access these data via the GKT for their own use would be very effective.

Another reviewer mentioned the same need to be able to access local data, in this instance local spatial analysis results of, for example, threatened species. Working in a regional office but having to conduct spatial analysis in areas of parks, it would be beneficial to be able to tap into the work undertaken locally because local staff would be more aware of local issues and priorities. Apart from duplicating work, the regional and local analysis results, although similar, were rarely the same. Another example described of useful local data was the ability to access people’s research reports that are
not yet finished, even if only knowing about their existence through digital records. However, the issue of copyright of local data was simultaneously raised. For instance, local research conducted by external companies could not always be made available to others.

Other examples of activities noted where the tool could be useful were biodiversity services and projects, the handling of queries by staff of the organisation’s Information Centre and those assisting parks visitors with queries face-to-face, and business operations in general. For the latter, the GKT would have to link to Parks Victoria’s financial systems to be able to cross-reference individual staff members with their rosters, their daily activities, projects they were working on and so on. This in turn could link to the financial aspects of those projects such as what stage the project was at or how much was spend to date.

One final comment suggested that the tool would be useful for detailed activities such as monitoring and planning, but it was less certain how relevant it would for broader, operational users.

### 6.2.3 Comments in response to questions C and D

<table>
<thead>
<tr>
<th>Question C:</th>
<th>What do you think of the overall design of the tool?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question D:</td>
<td>What do you think of the overall usability or ‘ease of use’ of the tool?</td>
</tr>
</tbody>
</table>

The responses received regarding question C could broadly be divided into two categories. Apart from a few comments on the appearance of the tool – that it was attractive to look at and that the colourful nature of the screen was liked – feedback either related to the map or geographic aspect, or else discussed the overall design and functioning of the tool with some mentioning specific design elements. Most of the responses to question D fell in this second category, and were therefore combined with those of question C. The remaining comments in response to question D generally voiced an opinion or concern, and are discussed at the end of this section.

Although the size of the map area in a GKT would supposedly be adjustable as required by the user, this was a non-interactive part of the demonstration prototype. Three reviewers therefore commented on the relatively small map area of the tool, although
one added that the map was probably not the most important aspect of the prototype.

[Author’s note: that is partly correct in that the map component is only partly
interactive, and primarily functions to demonstrate how data are linked to geographic
locations – refer Figure 5.46 in Chapter 5.7.5]. Seven saw it as a positive to have the
geographic context (map and data link), and five suggested to add additional
information to the map. This included basic map details like contours, streams and
topography at appropriate scales, whereas some suggested that georeferenced data such
as GIS or ParkView data could also be overlayed on the map. Others referred to being
able to visually add spatial information and geodata more generally. An example given
was that the ability to search and graphically represent community issue and complaint
data would be a great opportunity. One reviewer warned however that additional data
layers could overcomplicate the map, adding that if people wanted more advance
mapping tools they could use another system. Another reviewer therefore suggested the
tool should be integrated with existing Parks Victoria systems, and not be a system that
duplicates what other systems already offer.

Two reviewers suggested to use a GIS based mapping system instead of Bing Maps,
used for the prototype. The Mapshare system applied to FireWeb and other DSE
mapping applications was given as an example of an existing mapping system that
could be considered. It was deemed useful because it does not draw ‘live’ from the GIS
data behind it, which would make the system slow, but instead relies on the GIS
database being updated periodically. A final response in relation to the geographic
aspect stated that it would be good to be able to zoom into an area of the park, but
referred to the previously mentioned issue of the level of detail in the data attributes to
be able to give detailed results.

Comments other than those related to the map or geographic aspect generally covered
the overall design and functionality of the tool or specific design elements. For example,
seven reviewers thought the tool was simple and easy to use and navigate, whereas four
mentioned it was straightforward and intuitive. The tool was regarded to have a clear
and logical layout, whilst the one page display that allowed refinement of results was
viewed as positive. One reviewer thought the three-step process to obtain relevant data
at the level needed as useful. Another commented that it was a good impression of how
a tool could work, given it was only a partially functioning prototype. One response to
question D further stated that the usability was great. Nonetheless, two comments
suggested that a guide or further instructions were required, for example to explain the options for geographic attributes and to explain the confidence rating system, although adding that the concept of the latter was good.

Seven reviewers commented on specific design elements. The folder names made sense to some, referring to the My Space, Settings and Help buttons at the top, whereas others regarded the data categories as fine or logical. Another reviewer proposed to change the order of the data tabs however, grouping Parks Victoria's corporate and local data and putting DSE next to partner organisations. This could perhaps be solved by the suggestion of another reviewer who mentioned that it would be important to have flexible data fields suitable to the user rather than 10 predefined data types. Other comments similarly suggested for users to be able to customise view options. The commenter was not interested in social media data, and rather than having to deselect that particular tab each time, the tool should be able to save personalised settings.

It was also proposed to separate the data blocks better and have more space between them, whilst another comment suggested redesigning the map/data layout. Instead of having the map at the top and the data at the bottom, the map could be on the left and the text to the right. It was mentioned that this was a personal preference however, as it would make the design in line with the reviewer’s other systems in use. One reviewer proposed to eliminate the small maps used to zoom back/forwards and instead use the browser’s back button, provided the tool would be Web based. Lastly, a comment referred to the choice of font as not ‘engaging’, whereas two people brought up the choice of colours, commenting that particularly the dark columns were almost unreadable. It was added that users could perhaps change colours to their liking.

Finally, in response to question D, three reviewers voiced their opinion in the comments. One stated that the concept of the tool seemed good, but that it was hard to visualise what the results would end up with if a real live search were conducted. Another comment in a similar context stated that more work would be required, and that a bigger dataset was required to see the full potential of the GKT. The last comment related back to the issue of level of detail of data attributes, and what detail search results would produce. The concern raised was that such results could provide the user with a lot of information that could be too much.
Apart from one, all reviewers wrote down at least one comment. Some revealed issues already mentioned by others during earlier questions. The vast majority of topics related to the functionality and design of the tool. The remainder related to the map or geospatial aspect, aspects of data, maintenance or were regarded as opinions.

Two comments regarding the geospatial aspect viewed this component of the tool as important and useful. One referred to their ‘geographic way of thinking’, and thus preferring geographic interfaces and being able to draw an area on the map rather than using keywords to find relevant data. The other suggested that all Parks Victoria’s data are geographic and the organisation should undertake all its work spatially. Another map related comment proposed that the map ability should be increased to include different layers and maps such as GIS or ParkView layers as well as aerial imagery, Melway maps, fire maps and park maps for instance. However, another reviewer suggested that ParkView and the GKT could function together rather than having one tool that does everything.

It was also proposed to increase the geographic options for selecting data; a useful additional category would be DSE managed Crown Land that often adjoins Parks Victoria managed land. With regards to the map tools, it was mentioned that the zoom and selection tools should be able to produce areas other than rectangles, with the option to also exclude areas from a selection.

Several of the comments relating to data discussed the usefulness of linking data. One reviewer envisaged a visual representation of connections between data sources as a mind map. These linkages could either be automatic or the user could create the links themselves. A simple tool to link data, such as a ‘drag and drop’ option, could also be...
very useful. Another reviewer wanted to be able to map the links between data sources in their work area, in a similar fashion to a Microsoft Access database.

Four reviewers proposed additional data columns to house additional data divisions. Suggested categories included people, projects, spatial data – to accommodate spatial data created by regional offices – and operational data. The latter were described as the end product of planning and included pest plant and animal work, revegetation and erosion. It was argued that making these more prominent on the GKT would foster improved recording of such data and this facet of management. The comment contradicted other comments suggesting the tool might have little use for fieldwork and operations. One reviewer commented on the overlap between researchers that are partners, and queried if these data would be in the Partners or Reference categories. It was proposed that such an issue could be resolved through defining the title differently or more clearly.

Several comments concerning the functionality of the tool discussed the ability to personalise the tool. One preferred to be able to change the layout of the tool, to choose the size and position of the map and data components, whereas another regarded the user settings as a means to improve user satisfaction with the tool. User options mentioned included the ability to vary data field types and the ability to add ‘trust’ settings to the Partners and Local data categories. One reviewer also suggested that data saved in My Folder should be shareable as it would be useful for staff working together on projects.

The ability to conduct an advanced search and set parameters for a search was listed by four people. One reviewer thought the keyword search option could be improved by having predefined topics and subtopics rather than typing in keywords. It was also suggested to provide links to existing systems and increase the capability of the tool by incorporating a wider spectrum of uses like email, the finance system and time sheets.

Other user tools mentioned were the ability to save data to a person’s own computer drive rather than the folder provided by the GKT (My Folder), and an additional button that allows people to create reports. The question was asked if the tool would allow users to make documents from all the different sources within the tool, or if text, maps
and images would need to be cut and pasted into a *Word* document in order to produce a report.

A few issues regarding specific design elements were brought up. It was firstly suggested that the tool should be designed to cover the full screen. One reviewer mentioned the choice of colours, whereas another suggested showing less detail in individual data boxes [Author’s note: the reviewer referred to more refined search results that present individual documents]. Only hovering over a box should give detailed information. Lastly, the issue of appropriate data access was mentioned. It was suggested to add security profiles to address the issue, referring to a ‘role based access controls’ model that had been previously investigated for another Parks Victoria project.

The issue of maintenance was briefly raised by a three people and was mentioned as being important. It was suggested that it could be difficult for someone at Parks Victoria to upkeep data and control or keep an eye on relevant digital archives. Instead, technology should be used to assist with this and assign keywords for example, whereas dynamically linking data would ensure they remain current. Examples of such data provided were stakeholder and contact lists.

Seven reviewers commented on examples of data provided in the tool during the face-to-face discussion. These included specific examples in the categories Local, Legislation and Partners data, as well as all five alternative data sources. Most of the reviewers either recognised the potential relevance of those data to the use scenario topic – an ecological burn at WPNP – or else deemed the data source as useful in general. An example of the former was the local New Holland Mouse research data, whereas the CSIRO and the ABC’s Four Corners interview with Professor David Lindenmayer were discussed as examples of the latter. Social media and Media data were generally regarded to suit some activities and not others. One reviewer pointed out that some of the data shown in the prototype were not relevant to the topic in their opinion. This is arguably where the limitations of the demonstration prototype showed, in that it did not draw on live data but only on a selection of data examples chosen by the researcher.

Finally, five reviewers voiced their opinion regarding various issues. One wrote that the confidence rating is a good idea, but did regard it as difficult to assess as it varies for
people although it should be easy to apply such ratings to spatial data. Another reviewer had the personal opinion that data in the Media category should not be given a high confidence rating if any at all. One person stated that the system would have to be fast in order for it to be useful, including the use of maps, whereas another reflected back on the importance of attaching appropriate and detailed attributes to data to make the tool effective, and the prior need to digitise all data. A somewhat reflective final comment saw the ‘real long term potential for the tool to be the single point of truth for all data associated with parks’.

6.3 Discussion: feedback and the geo-knowledge tool

The combined written and verbal feedback covered issues relevant to the development of an actual GKT. The following sections discuss key comments in relation to such a tool, finishing with a summary of considerations in point format. The feedback is categorised using broad topics found in comments in the previous section 6.2. Details are omitted to reduce the level of repetition that unfortunately cannot be avoided.

6.3.1 Purpose and functionality

The suggestion that the tool would be useful to find data relates to the point mentioned in section 5.7.6.1: whether the primary capability of the GKT was to make data ‘accessible’ or ‘findable’. At least three reviewers would find a tool that lets them find and locate data very useful, whilst it appeared less important for them to be able to access data via the tool. It was previously presumed that the GKT would provide access to data in the broader sense of the word: find, open and use the data. If the greater problem at Parks Victoria is finding data, than perhaps the purpose of the GKT could change. However, it would seem more effective if a tool that finds data could simultaneously provide access to that data – either using the system’s own capabilities or else by linking directly to other systems with such capabilities.

The ability of the tool to provide access to additional data beyond Parks Victoria’s traditional data was generally viewed as useful. Alternative data could benefit the organisation’s data, whilst access to a broader range of relevant data would assist decision-making for different management and practical functions. It was apparent, however that some positions and activities were more suited to benefitting from such data. They would similarly benefit from different alternative data sources such as Parks
Victoria local data versus data on the Web. Key to the effective use of these additional data, however is the ability to limit them.

Judging by the proposals for the tool to show GIS data and the ability to overlay other data on the map, the suggestion to apply a GIS based mapping system seems logical – whether that is DSE’s Mapshare system or Parks Victoria’s own GIS data. As mentioned in Chapter 5.7.4, the research project presumed that a GKT would either incorporate a live version of a mapping tool like Bing Maps or Google Maps, or else would draw on the organisation’s GIS data, similar to ParkView.

### 6.3.2 Personalisation ability

When designing the demonstration prototype, it was already envisaged that aspects could be personalised. Seven reviewers between them suggested a number of areas where this could apply. Key suggestions were the ability to customise data categories, visible map layers, and for the system to remember their personal preferences. A login would thus be required, which would also allow for the user’s personal data and data suitable to their role to be presented. Personal user settings could simultaneously address the issue raised about the choice of colours – the ability for users to choose from a range of colour sets was previously proposed in Chapter 5.7.5.

These suggestions seem very useful in practice. Rather than having a fixed set of predefined categories that people can turn on and off, people could choose up to a particular number of categories based on any or a given set of keywords. Providing users with data relevant to them could make the tool more effective and efficient, although care would have to be taken that users do not miss out on data as a result. If data are restricted, they might have to be presented as digital records so people still become aware of the data’s existence, but have to request access to the data. Nonetheless, it is envisaged that a smart system could also recognise what data are more important to different users, and present these data higher up in the results - similar to Google's ranking algorithm perhaps. Additionally, if the GKT was used as a single interface for all data and systems, this initial login could also function as the single login to other systems such as FireWeb.
6.3.3 Search results

The effectiveness of a GKT would be dependent on the usefulness of the results returned. The search capability of the tool is thus an important issue, with a clear requirement to be able to set parameters. Without the ability to refine searches, users would be presented with a lot of data, which would not be effective. Taking the catalogue of the State Library of Victoria\textsuperscript{122} as an example, which has a range of parameters that users can apply, this suggestion would seem feasible. Additionally, a GKT should be able to search within documents and take the user to a relevant section within document rather than present the document itself. This was alluded to in Chapter 3.2.2, when discussing Parks Victoria’s Gathering of Wisdom project; how could the tacit knowledge of park rangers captured on video be used effectively without appropriate keywords at certain intervals in the one-hour videos.

The usefulness of search results would also rely on the level of detail in the attributes attached. The research project always envisaged that the data would be categorised in detail. For instance, the demonstration prototype provided the example of the New Holland Mouse being present after zooming into the burn area. As described in Chapter 4, Parks Victoria field data are increasingly collected using GPS enabled devices, thus creating detailed geographic attributes. Such detailed geographic information should retrospectively be applied to all existing data if the requirement of several reviewers is to be fulfilled.

Alternative data should be categorised to a similar detailed level. However, if this is feasible from a technical perspective and how that data could then become searchable and be made available via the GKT is unknown.

6.3.4 Digitising and categorising data

Finally, the feedback revealed a number of opinions and concerns relevant to the GKT. These included recognition of the effort required to digitise and categorise Parks Victoria’s data. It was proposed that digital records could be created instead with relevant keywords, geographic attributes, summary and the like. It was further suggested to commence with ‘high level’ data and broader categories and specific details later. However, this would undermine the effectiveness of the GKT, as it seemed that the detailed and local data in particular are regarded as useful to be able to find. Digital records would be useful for data that cannot be digitised or that are restricted

\textsuperscript{122} Refer www.slv.vic.gov.au/explore/research-tools.
and cannot be made accessible in full via the tool for various reasons including copyright or user restrictions. Such restricted data would thus become findable by people.

Arguably, if the purpose of the GKT were to find data only, it would eliminate the need to digitise data, as digital records would suffice. This would require people to go through the data and record all relevant metadata. Therefore, once that effort was made, it would seem a relatively minor next step to also digitise the data at that point, although opinions on that may differ. It is ultimately up to Parks Victoria as an organisation if they wish to invest resources – money, staff, time – to digitise its data, categorise them thematically and geographically to varying levels and apply a quality search mechanism that would give refined, in-depth, appropriate results to suit staff and other potential users.

6.3.5 Summary of main design considerations

The previous sections are summarised in point format to give an overview of the main elements identified from the demonstration prototype feedback that should be considered for a future GKT based on feedback from reviewers of the demonstration prototype. The main elements to consider are shown in Table 6.2.

These design considerations would form part of the conceptual model of the GKT. The original conceptual GKT, described in Chapter 5.6, incorporated some suggestions already, such as the search and categorisation aspects, but not to the detail outlined above. The methodology for the confidence ratings, described in Chapter 5.6.3, identified a range of data attributes including year of creation. Although applied to assess the quality and usefulness of data, it was envisaged that at least some of these data attributes could also be used to refine search results. The personalisation aspect was also identified but not applied to all areas suggested by the reviewers. The findings from the reviewers' feedback can therefore assist in refining elements of the conceptual model, or can be added to the model as additional explanatory notes. The conceptual model and accompanying notes form the basis for the development of an actual GKT.

6.3.6 The next step

It was expected that the next step following the review of the demonstration prototype would involve amendments based on the feedback received. The demonstration
<table>
<thead>
<tr>
<th>Consider the purpose of the tool:</th>
<th>‘Access’ or ‘find’ data.</th>
</tr>
</thead>
</table>
| Effectiveness of tool dependent on results return, which depend on: | Level of detail in data attributes.  
Advanced search capabilities that include:  
- Set parameters;  
- Use keywords and phrases;  
- Auto-completion of keyword categories and subcategories;  
- Search within documents. |
| Tool should have ability to personalise: | Data categories;  
Map layers;  
Overall layout. |
| Therefore, a user log-in is required to: | Save personal settings;  
Present data appropriate to user role;  
Present personal details. |
| Additional functionality suggested: | Use (existing) GIS based mapping system;  
Overlay georeferenced data on map;  
Highlight data linkages;  
Create reports from data saved;  
Share data saved with others;  
Choose colours. |
| Considerations for effort in digitising and categorising data: | Commencing with broad/high level data diminishes effectiveness of data results;  
Create digital records instead  
- Finds data including restricted data but does not provide access. |

Table 6.2 - Main issues to be considered for a future GKT based on feedback from reviewers of the demonstration prototype.

Prototype could then be reviewed again if required. The feedback received, however, was not regarded to warrant this. This was primarily due to the scope and technical aspect of comments. This arguably correlates with the technical simplicity of the demonstration prototype, its limited technical capabilities and user interaction as well as the open nature of the questions that asked people to raise any issues or ideas they regarded as relevant.

The majority of responses put forward by reviewers were outside the prototype’s technical scope – the search capabilities requested, the suggestions proposed for the map area, and the ability to personalise the tool for example. If a more sophisticated,
technically advanced prototype were developed, it would most likely have incorporated some of the suggestions in the initial version of the tool.

The issues raised with regards to the level of attributes and digitising of data were relevant to the conceptual model in that they would need to be addressed if a GKT was to be built. The research project would not provide solutions as to how that could be achieved and the issues fell outside the scope of the demonstration prototype. The few comments that related to specific elements such as the choice of colours could have been applied to amend the demonstration prototype. However, these issues were not regarded to play a major role in assessing the effectiveness of the tool.

Having eliminated the need to amend the demonstration prototype, the feedback instead would be considered for the conceptual model of a GKT and recommendations for a future GKT.

6.4 Discussion: findings and research objectives

What do the findings mean for the research project? Do they assist in addressing the primary objectives and contribute to answering the research questions posed? The theoretical methodology for a GKT – comprising a conceptual model and demonstration prototype – was developed to address the objectives of the research project. The GKT was regarded to be a geographically oriented knowledge system that would provide access to both Parks Victoria's existing data and additional data found on the Web. The underlying theories were firstly that Parks Victoria's existing data were not utilised as effectively as they potentially could be, and were not readily accessible when they could potentially assist decision-making. Hence, a methodology for enhancing data access and utilisation was required. The second underlying theory was based on the Web 2.0 notion that information contributed by users of participatory tools has the potential to be valuable, and could potentially benefit existing information. The research project would assess if alternative data sources could potentially complement Parks Victoria's existing data. The research project broadened the concept of UCI to include existing data on the Web, contributed by governments, media organisations, businesses and the general public – experts and non-experts alike – via websites or social media applications. These so-called digital data repositories found on the Web were not traditionally considered by Parks Victoria, which instead generally relies on traditional data from trusted expert sources.
The research project posed the following research questions:

1. Can a digital archive that contains georeferenced data in different formats be effectively visualised to represent knowledge?
2. Can non-traditional data sources be amalgamated with mainstream data to form part of an effective knowledge tool to potentially assist decision-making?
3. Can the alternative data accessible through such a tool potentially complement existing data, improve knowledge or fill information gaps?
4. Can contemporary Web concepts be successfully applied for the development of the tool?

Additionally, the research project considered a number of secondary questions:

i. How can different user groups access and utilise the archive appropriately?
ii. Can different user groups maintain and add to the system’s data content?
iii. What methods or principles could assist in assessing the data quality of alternative data sources?

The following sections look at the four questions and answer each based on findings from the various components of the research project: the initial investigative phase, the case study and related activities, and the feedback obtained from stakeholders regarding the demonstration prototype. Answers to the secondary questions are incorporated into the four primary answers when relevant.

6.4.1 Response to research question 1

Can a digital archive that contains georeferenced data in different formats be effectively visualised to represent knowledge?

Answering the first research question is not straightforward. The primary outcome of the research project was the development of a theoretical methodology for a geographically oriented knowledge tool for accessing Parks Victoria’s data archive – described as a GKT. The ‘success’ of this tool is essentially the answer to the first question. Based on the comments from stakeholders who reviewed the demonstration prototype – representing the conceptual GKT – the proposed tool was regarded to make
better use of Parks Victoria’s data. Having access to all organisational data in one tool was regarded as positive, with the potential to be the single point of truth.

However, can the tool visualise data effectively to represent knowledge? As outlined in Chapter 3, information is data rearranged so relationships can be understood whilst knowledge involves recognising relationships and patterns in the information. Diderot’s *Renvois*, described in the same chapter, was based on the premise that linking data and providing access to different data could assist in the creation of knowledge, as it would force people to think rather than follow a predefined hierarchical structure. It is argued therefore that a knowledge tool should present data in such a way that relationships can be understood and patterns identified so the data become something meaningful to users. Additionally, such a tool should provide access to different data. The proposed GKT did the latter: it provided access to both traditional and alternative data not traditionally relied upon by Parks Victoria. The tool also applied several techniques to show relationships. The main method was to categorise data using multiple keywords representative of the data content. Applying such a faceted classification means that users can find data to suit different needs. The categories include thematic and geographic keywords, whilst a map allows users to see connections between and within data and geographic locations. Maps are traditional means to visualise georeferenced data in an organised manner.

Being able to refine data using a number of options, including the reviewers’ suggestions for additional parameters within searches, would mean that people are presented with a collection of data that are connected by theme, location and other attributes that should enable them to make sense of the data. One aspect of knowledge identified is its dependency on the ability of people to understand. Thus, it is argued that the GKT uses different techniques to present and visualise data in a structured way that identify relationships, thus forming the foundation of a knowledge system. It is ultimately up to individual users whether they can recognise and understand the structure and links and thus acquire knowledge.

6.4.2 Response to research question 2

*Can non-traditional data sources be amalgamated with mainstream data to form part of an effective knowledge tool to potentially assist decision-making?*
The first component of the question has been answered in part in response to the first research question. Access to different data is regarded to assist the acquiring of knowledge. The proposed GKT would provide access to traditional and alternative data using thematic and geographic keywords to identify relationships. The feedback from reviewers of the demonstration prototype suggested that the tool indeed has the potential to assist decision-making exactly because of the immediate access to alternative data sources in addition to Parks Victoria's existing data. A number of management facets and activities were identified as benefitting from access to additional data, comprising both existing data repositories on the Web and local data that have not traditionally been easily accessible by staff.

However, the effectiveness of the tool and thus its capacity to assist decision-making are dependent on a number of things. The primary issue is the quality of the search results returned, which relies on the capabilities of the search mechanism to refine data and the level of detail in the data attributes. As pointed out, without adequate options to limit data results, the vast amount of additional data could become too much and unworkable, and people may not be able to recognise the potential relevance of data because the linkages are not made clear. Presenting users with too many options would diminish the potential value of the additional data and thus reduce the effectiveness of the purpose of the GKT. The initial four refinements provided by the demonstration prototype were a first step, but users should be able to set additional parameters within these search options. Auto-completion of searches using categories and subcategories would further benefit the search refinement. The level of detail in the attributes is similarly important. If a decision-maker zooms into a small area of a park but is only presented with broad data not specific to that area, the data may not be suited to make effective decisions.

A third consideration is the quality of the data, more pertinent to alternative data. Chapter 5.6 described quality and usefulness of alternative data as an issue, and a theoretical solution was proposed to address this, which answered the secondary research question iii – what methods or principles could assist in assessing the data quality of alternative data sources. Arguably, decisions can only be as good as the quality of the data they are based on. If they are based on lesser quality data, this must be known so the implications can be understood. Therefore, an effective GKT would provide users with the ability to assess the quality and usefulness of alternative data to
suit their needs. Having confidence ratings attached to data as the research project’s solution proposed, would benefit people in assessing if the data are appropriate to apply in their decision-making.

6.4.3 Response to research question 3

Can the alternative data accessible through such a tool potentially complement existing data, improve knowledge or fill information gaps?

It would seem that the alternative data can potentially complement Parks Victoria's existing data. Different roles and activities have different data needs, and people who would benefit from easy access to alternative data seemed to appreciate that function of the GKT. The general purpose of the alternative data required by staff appeared to simply be the need for additional data that are not obtainable from or provided by Parks Victoria. Planning and monitoring were named as examples of activities that use additional data, where the role of these data is essentially to be background, base or research data. Background and research data were two categories of additional data needs identified by reviewers. The alternative data therefore tend to complement Parks Victoria's data or fill information gaps. The data are generally not obtainable from Parks Victoria sources, or else are needed in addition to existing data.

Because staff have different data requirements based on their role and duties, it would be logical to adopt a flexible approach to data categories, as suggested by reviewers. Users should be able to personalise the data displayed and choose data categories appropriate to their needs. A log-in mechanism could ensure that only data appropriate to a user’s role would be presented, or else could potentially be prioritised in the search results. Such a security setting would also answer the secondary question i, ensuring that different users can access the data appropriate and effectively. This would not only concern different staff members at Parks Victoria, but also other potential users of the tool including stakeholders and the general public, as described in Chapter 5.2.3.

Based on the feedback from stakeholders, it can not be said with any certainty that alternative data can improve knowledge of Parks Victoria staff – although in a theoretical sense they would most likely do so. As aforementioned, knowledge is about understanding patterns and relationships of data and information. The additional data people require form part of this framework of patterns and links, and once accessed and
applied, could thus enhance existing knowledge. When taking alternative data to include local data not traditionally accessible, alternative data may surely enhance knowledge. Some staff members in regional offices, who would like access to local data, do so presuming the local data are better than if they were to produce the data themselves. This is because the local data takes into account local knowledge. Having access to such local data therefore should in turn improve the knowledge of these regional users.

It must be noted that it is uncertain if users were able to conclude that access to alternative data could be beneficial because of the demonstration prototype or because of their own need for alternative data, and thus the belief that the concept is useful.

6.4.4 **Response to research question 4**

| Can contemporary Web concepts be successfully applied for the development of the tool? |

The research project considered contemporary Web notions of Web 2.0 and developments in the geospatial realm. A key concept of Web 2.0 is UCI, which the research project defined under the broader banner of alternative data comprising existing data on the Web made available by organisations and individuals using participatory tools. The purpose of the GKT was to provide access to these alternative data in addition to Parks Victoria’s data – without the former, the tool would merely be a means to access the latter, albeit potentially enhanced. Because alternative data formed part of the GKT, it can therefore be argued that yes, the application of this contemporary Web concept did benefit the GKT. Section 6.4.2 more or less expanded on this, as the concept was inherent in the second research question.

The collaborative and participatory aspect of Web 2.0 formed part of the proposed methodology for the confidence rating. It was envisaged that users would be able to add their ratings and comments concerning the usefulness of data, which would see the system evolve overtime and improve as users are using the data. The conceptual GKT also listed a number of other participatory and collaborative tools available to users, such as wikis and blogs. Several reviewers recognised the usefulness of such tools for the capturing and sharing of data and to collaborate with other team members.
The ability to personalise aspects of the tool as suggested by reviewers is also a Web 2.0 concept. Rather than being presented and having to work with predefined data categories and map layers, giving users the opportunity to adapt these to suit their needs is deemed logical and useful, and would enhance the user experience. Their data requirements would be met more easily and it would thus make the tool more efficient overall.

Considering the findings of Chapter 2, the Web 2.0 principles of participation and interaction have been widely embraced for personal and business purposes, with social networking sites like Facebook and YouTube, Twitter, blogs and discussion forums growing in popularity. Social media have become commonplace and have emerged as a powerful communication tool to distribute information to serve many different purposes. The park visitor survey, described in Chapter 5.5, stated that around 76% of park visitors who use the Internet use social media tools. Like the increased use of social media in Australia in general, usage of such tools amongst park visitors may similarly have grown since the survey was conducted in September 2010. In view of this, applying such principles to the GKT is appropriate.

This also answers the secondary question ii – whether different user groups can maintain and add to the system’s data content. Essentially, any potential user of the GKT can contribute to the data content through its participatory components, including the ability to rate and comment on alternative data sources. The visitor survey further revealed that park visitors could be specifically asked to contribute information through crowdsourcing projects organised by Parks Victoria. Because they are using participatory tools and have a general interest in parks, they could also contribute potentially useful information passively through their use of existing collaborative Web based applications.

It was initially envisaged that the proposed GKT could utilise the collective intelligence resulting from UCI contributed by individuals. The feedback on the demonstration prototype did not as such reveal that such collective intelligence was useful. Instead, individual items of UCI generally seemed to be required. This again may correlate with the nature of the demonstration prototype that provided access to limited data examples only. If the tool was used to obtain community feedback, required for park management planning, or to engage the community for example, these data may well be representative of the collective intelligence of the community and function as such from
the perspective of Parks Victoria. The park visitor survey demonstrated that the organisation could consider crowdsourcing projects and involve visitors to contribute information collectively or to collect data as about 65% of visitors may actually participate and contribute. Like the Rabbitscan and Commons projects mentioned in Chapter 2.3.6, crowdsourcing and capturing individual bits of knowledge could potentially contribute new knowledge or could enhance existing data.

Considering Web concepts in the geospatial realm, the reviewers' feedback suggests that the proposed interactive map and mapping tools would be useful. With Parks Victoria data inherently geographic, being able to zoom into a geographic location and be presented with data relevant to that location would be beneficial for different users and activities. However, because Parks Victoria uses other mapping systems including ParkView, FireWeb and ArcGIS, it would be feasible that the mapping capabilities of the GKT could be relatively simple in that they do not have to replicate other systems but instead function alongside each other.

An associated issue identified was the variation that existed in how data are georeferenced. Geographic attributes can vary in format, depth and accuracy, in turn affecting their quality and usefulness. The theoretical solution proposed in Chapter 5.6.4 aimed to address this issue. Although both Parks Victoria and alternative data increasingly comprise detailed geographic information due to the application of GPS enabled devices to capture data, the issue would have to be addressed in order for the GKT to present all data relevant to a geographic location and thus make the tool more effective.

6.4.5 Point summary of responses to the research questions

The above sections 6.4.1 to 6.4.4 are summarised in the following points:

- The methodology for the GKT is a means to make better use of an existing data archive;
- The GKT uses different techniques to present and visualise data in a structured way that identify relationships, thus forming the foundation of a knowledge system and enabling users to make sense of the data;
- Immediate access to alternative data in addition to the existing data archive is beneficial;
The effectiveness of the GKT and its capacity to assist decision-making is dependent on the quality of the search results returned. This is affected by the capabilities of the search mechanism, users’ ability to refine search results as required, the level of attributes attached to data, and the ability to assess the quality of alternative data;

Alternative data can complement Parks Victoria’s existing data and fill information gaps;

Certain activities and roles specifically would benefit from easy access to additional data that are categorised and presented according to user needs;

Access to additional data should, theoretically at least, improve knowledge;

The collaborative and participatory aspect of the proposed confidence rating methodology are regarded to enhance the system over time;

The proposed Web 2.0 tools can be used to capture and share data, and collaborate with other staff (team or project) members;

The proposed capability to personalise aspects of the GKT means users are presented with data relevant or appropriate to them and their position;

Park visitors can provide potentially useful UCI through crowdsourcing project or Web based participatory tools;

The proposed interactive mapping component of the GKT links data to geographic areas and allows data access data using geographic attributes; and

The effectiveness of the geographical search capability requires a sufficient level of detail in data’s geographic attributes, whilst alternative data must similarly be georeferenced appropriately.

6.4.6 Brief discussion

The answers to the research questions are positive, which means the objectives of the research project have been fulfilled. The proposed GKT is deemed capable of visualising digital georeferenced data effectively to represent knowledge, whilst traditional and non-traditional can be amalgamated into the tool to assist decision-making. The non-traditional data have the potential to complement traditional data and fill information gaps to theoretically assist knowledge creation. Contemporary concepts of Web 2.0 and the geospatial Web can benefit the GKT.

The positive outcome is arguably at least in part linked to the theoretical aspect of the research project. The aim was to develop a theoretical methodology for a GKT. Because
of this theoretical nature of the overall outcome, the demonstration prototype was a simple tool that aimed to demonstrate a theory rather than be a technically advanced, fully interactive prototype that would also show how a GKT would technically function. The demonstration prototype therefore had limitations that included selective user interaction with limited search capabilities, whilst it also did not provide access to real data. However, it did demonstrate various proposed functions as non-interactive components, while the envisaged capabilities of a GKT were also explained during the discussions between reviewers and the primary researcher. Reviewers of the demonstration prototype were essentially asked to consider what a real GKT could do and how it might benefit them. The results indicate that the majority seem to consider such a tool as being potentially useful. Merely being able to find and locate any Parks Victoria data would be beneficial, whilst the addition of alternative data in the one tool would seem worthwhile and assist a number of management facets and activities. Therefore, despite the limitations of the demonstration prototype and the theoretical nature of the research project's outcome, the underlying theories are agreed upon, and the resulting research questions can be answered positively. Nonetheless, the next step would be to apply the theoretical findings of the research to a practical application. This will be discussed in more detail in the next and final Chapter 7 – Conclusion and Recommendations.

6.5 Chapter summary

The purpose of this chapter was to firstly analyse the findings of the reviewers’ feedback on the demonstration prototype, and to subsequently discuss these in relation to an actual GKT as well as the primary objectives of the research project. Relevant findings from other chapters and activities were also applied to the latter discussion.

The chapter firstly provided an analysis of the reviewers' comments on the demonstration prototype and the underlying theories. The comments were outlined along the format of the feedback form that comprised five questions. The written and verbal feedback received from the 13 reviewers revealed generally positive attitudes towards the underlying concepts. Having access to a broad range of data in one tool was regarded as positive, whilst the inclusion of additional data would be advantageous to a range of activities. It was recognised that certain positions and activities would benefit more than others. A key issue to be considered to ensure a GKT would be effective and alternative data results in particular would not become too much, was the need for
advanced search capabilities to refine data. Additionally, the usefulness of results would also be dependent on the level of detail in the data attributes. Reviewers proposed to be able to personalise aspects of the tool to suit different users' needs. These included the need to choose appropriate data categories, add different map layers, and for a GKT to recognise a user to therefore be able to provide data appropriate to that user's position and person. The design, layout and usability of the demonstration prototype was generally regarded as positive, although a number of suggestions were made as to how some aspects could potentially be improved.

The feedback received from reviewers of the demonstration prototype was subsequently discussed in relation to an actual GKT. Some of the key considerations revealed already formed part of the conceptual model of the GKT that had been developed, but the additional detail could supplement the explanatory notes.

The reviewers' feedback was regarded to be at the core of the research project, as it informed and assisted the researcher in trying to answer the main research questions. The final section therefore discussed the findings combined with those from other chapters and activities in relation to the research project's primary objectives, and addressed the four research questions posed. The four research questions that collectively encapsulated the research background and primary objectives were answered in the affirmative. The aims of the research were thus achieved through the development of a theoretical methodology for a GKT. This GKT was regarded as useful for presenting both traditional and non-traditional digital georeferenced data, with the latter seemingly capable of complementing the former.

It was argued that the positive outcome of the research project was at least in part affected by the theoretical nature of the research outcomes and the limitations of the demonstration prototype. This meant that reviewers were asked to envisage the potential capabilities of such a tool, with most having positive expectations. The next step, however, would be to apply the findings to a practical realm.

The next Chapter 7 – Conclusion and Recommendations – discusses such a step in more detail. The purpose of this next, final chapter is to reflect on the thesis outcomes and provide recommendations for future work. It firstly discusses the broader applications of the research project, away from park and fire management and planned burns. It then reflects on the possible implications of adopting Web 2.0. Following an outline of the
contributions of the research project, the next section outlines four recommendations for future areas of work. The chapter concludes with a reflection on the concept that followed on from Web 2.0: Web 3.0 or the Semantic Web. Can the findings of this research project that incorporated the emergent Web 2.0 be applied to the next generation of Web developments?
Chapter 7. Conclusions and Recommendations
7.1 Chapter overview

This final chapter of the thesis reflects on the research outcomes and proposes recommendations for future work. The first section discusses the outcomes of the research and how these might be applied to a broader area – not just park and fire management. The next section addresses the possible implications of adopting Web 2.0. The author’s view on whether the use of UCI, contributed by experts and non-experts alike, can undermine the scientific rigour and professionalism found in park management practices is provided. This is followed by a consideration on why organisations are joining social media sites. Is it because they are popular or because organisations believe in the potential social media holds? The final reflection on the research outcomes discusses the contributions the research project makes to improving parks management and to scientific knowledge in research areas generally. The next section outlines four recommendations for future work. The chapter concludes with a reflection on the evolving Web developments from Web 2.0 to Web 3.0 or the Semantic Web. As the conceptual GKT developed by the research project is a theoretical framework that can be applied for building an actual tool, it is addressed whether the framework can be adapted to suit the newly emerging semantic notions of Web 3.0.

7.2 Reflecting on research outcomes

The research project described in this thesis investigated whether access to and utilisation of an existing georeferenced data archive could be enhanced by applying the concept of a GKT. A theoretical methodology for a GKT – regarded as a geographically oriented, digital knowledge system – was developed for accessing the data and aspects of emergent Web concepts were considered for its design. The resulting conceptual GKT a) was a means to access the existing data based, in part, on the data's inherent geographic attributes; b) provided access to additional, alternative data found on the Web in public digital data repositories made available by organisations and individuals including data contributed via participatory applications; and c) incorporated concepts of Web 2.0 as well as mapping tools to represent the geographic component.

The primary aim was to assess whether the conceptual GKT provided an improved means to utilise the existing data. Additionally, the research project aimed to determine if the types of alternative data identified could potentially complement existing data and
if the adaptation of notions of Web 2.0 and the GeoWeb could contribute to an effective GKT.

Based on the feedback from stakeholders' reviews of a demonstration prototype – a proof-of-concept, partly interactive model built to assist the assessment of the underlying theories – it was deemed that the aims were achieved. The reviewers put forward a number of suggestions for enhancing the effectiveness of the tool and to ensure it would return quality, useful search results that were appropriate to varying user needs.

7.2.1 Broader application

Because Parks Victoria was a collaborator on the research project, the conceptual GKT was applied to the organisation’s existing park management archive. One of the national parks it manages, WPNP, and a portion of its data relating to fire management and ecological planned burns were selected for the conceptual model and the demonstration prototype. Reviewers of the demonstration prototype were mainly Parks Victoria staff who assessed the tool based on their experience and needs or those of their colleagues in park management.

It should be noted that the research outcomes are not just applicable to park management or fire management, and can be applied to other fields and areas. The research questions were worded purposely so as to encapsulate a broader application of the research aims and outcomes. The underlying issue that existing data are not used as effectively as they potentially could, might be present in other organisations that have vast collections of organisational and legacy data. The methodology for the GKT to enhance access to and utilisation of georeferenced data can be used as a framework for developing a practical solution by any organisation that strives to make better use of its existing data.

Arguably, the data do not have to be a georeferenced, as using the tool to simply find data could already be regarded as an advantage. When designing the tool interface, the mapping element could thus be omitted. However, a map metaphor can be useful to better visualise non-geographic data, as described in Chapter 3.6. Therefore, instead of omitting the demonstration prototype's current mapping element, it could be adapted or replaced by other visualisation techniques and tools that can help users to identify
relationships and structures in data, and enable them to ‘map’ data in different ways like a mind map.

The second underlying theory proposed that alternative data could potentially complement or enhance existing data. This equally applies to non-park management data. The tourism section, for example, could benefit from alternative data sources as exemplified in the conceptual GKT. Instead of relying on data contributed by professionals or from those with a vested interest, travellers or tourists who are willing to share their experiences via the Web could provide useful supplementary information. The type of UCI can vary, and it can be contributed passively and actively. Passively contributed information, for example, can be found in the tags and geotags of UCI such as photos on a photo-sharing site. Travellers can also be asked to contribute specific data via the Web, or to participate in crowdsourcing projects at a tourist location. Being able to track and analyse tourists’ movements or behaviours, by collecting passively or actively contributed data, has potential for a range of areas including planning and infrastructure.

There are already many websites with information contributed by tourists and travellers via participatory applications. Several traditional tourist information providers, established publishers of paper based travel guides, also have Web presences and host travel and discussion forums. Other travellers’ organisational sites provide similar information that is based on personal experience. Considering this wide range of tourist and traveller focussed public digital data repositories, potentially valuable data would seem to be plentiful in the tourism sector.

7.2.2 Potential questions concerning the adoption of Web 2.0

The question that perhaps needs to be asked is whether the use of alternative data – provided by experts and non-experts alike – would undermine the scientific rigour of sound park management practices. Does the reliance on or utilisation of alternative data reduce the professional approach to park management and the quality of the decision-making? The answer to these questions would seem to be ‘no’, provided the alternative data are used appropriately and proper checks and balances are invoked. The feedback from reviewers suggested that some Parks Victoria staff already use non-organisational data for certain activities, and that various types of alternative data are suitable for tasks like planning, monitoring and research. The GKT would merely provide easier access to
the data, and potentially be capable of providing a greater variety. Some reviewers stated that they only use certain data, like facts and verifiable data, whilst never needing data obtained from social media and media sources. This suggests that at least some staff members are aware which data are suitable for their needs. The GKT could therefore provide a range of data easily and instantaneously, with user defined parameters ensuring the data are relevant and appropriate.

Some of the feedback revealed a somewhat prejudicial, generally negative opinion of alternative data – although that arguably was aimed at data from certain sources such as social media and popular media. Therefore, the confidence rating system that attaches indicators as to the expected quality and usefulness of data would appear to be an important attribute to assist users when considering alternative data. Additionally, because the GKT can be used to find data one did not know existed, the staff members who stated they only wanted verifiable data could arguably be presented with new, appropriate quality data from alternative sources which they might be unaware existed or were applicable.

Essentially, applying alternative data supplied by experts and amateurs does not have to undermine sound management practices or scientific rigour, as long as the data are used appropriately with suitable assessment of quality and usefulness. Users could generally make decisions themselves as to data appropriateness, although it is feasible that a GKT could be designed to present only data appropriate to a user's needs or role. Numerous staff members at Parks Victoria already use additional data. The GKT could simply provide that data more easily and provide a larger variety including data from previously unknown sources.

Another question is whether organisations are exploiting social media applications due to their popularity – do organisations feel more or less obliged to join in – or is it because they believe in the actual concept or regard joining such applications to be useful? Arguably, it is not important why organisations join. What is relevant is how they use the social media tools once they have become a member. Simply joining social media applications but not actively using them or engaging with stakeholders (staff, customers or visitors) would most likely result in these stakeholders losing interest and not bothering to engage in return. The social media applications could simply be used by an organisation as a collective platform for stakeholders to engage and discuss topics and issues that are potentially relevant to the organisation. The organisation in such an
event would need to monitor what was being posted to ensure the UCI is appropriate. However, it would seem that if the communication process is bi-directional, the social media applications have the potential to be most useful. If the tools are used to actively engage with stakeholders – staff, the community at large or park visitors for example – they can be beneficial from a communication and engagement perspective. An organisation like Parks Victoria needs to engage the community and Web 2.0 tools have created opportunities to make that easier to do and to be done more efficiently. Additionally, if an organisation is actively engaged and provides relevant information that contributes to debate, the UCI it receives in return is likely to be more useful.

What organisations ultimately do with the actively and passively generated UCI is a different matter again. It is unsure how Parks Victoria plans to use UCI collected through their current social media presence other than it being a means to communicate with stakeholders. Perhaps once a sufficient amount of UCI can be collected and it can be analysed for details and patterns to emerge, only then might it be applied in the planning or decision-making process as appropriate.

7.2.3 Contributions

The outcomes of the research project provided multiple opportunities that can be utilised and extended. As outlined in the previous section, it is not necessarily important why organisations subscribe to social media applications but rather how they use the tools once they have a presence on the Social Web or have adopted elements of Web 2.0. This follows McLuhan's (1964) idea regarding new technology – that it matters more what people do with new technology than what the technology itself can do. Nevertheless, for an organisation to adopt emergent Web technologies for its benefit, requires an understanding of the potential advantages and disadvantages of social media and the participatory and collaborative notions that underlie Web 2.0. Once known, organisations can then apply or adapt these as appropriate. The outcomes from the research project provided insight into the potential opportunities and issues that should be considered.

The methodology developed for this research differed from Parks Victoria’s traditional approach to data collection because of the inclusion of alternative data sources and the application of Web 2.0 concepts. The notion that involving users – clients, visitors, staff – through participation and collaboration can potentially be useful is attracting much
interest, and the concepts are increasingly being applied by different organisations for different purposes. As mentioned in Chapter 4.5, Parks Victoria has utilised Web 2.0 tools for the drafting of two park management plans, and has, at time of writing, created a presence on four popular social media sites – Facebook, YouTube, Flickr and Twitter. The outcomes from this research can assist in providing further insight into the opportunities and benefits that a participatory approach might bring, and how it might improve park management and change practices.

The issues identified are not unique to Parks Victoria or the park management sector. As aforementioned, this implies that the theoretical methodologies developed in the research project can be adopted by other organisations or fields, with or without having an inherent geographical structure in place. The research touches various realms of geographic information and knowledge management, which can deal with the basic premise that existing georeferenced data are not used as effectively as they potentially could. This research project fits within different geographic realms and the results can contribute new concepts within existing areas, which can be applied and extended.

And finally, it is argued that the amalgamation of traditional and non-traditional data in an effective GKT could benefit all users of the tool and, in this case, assist park management and stakeholders through, for example, improved biodiversity and enhanced visitor services. If adopted by other disciplines, benefits should flow in a similar fashion.

7.3 Recommendations for future work

There are a number of recommendations for future work and extending this research. The recommendations proposed primarily focus on the transition from a conceptual model into a practical application and thus assist the adaptation and transformation process into other areas.

7.3.1 Recommendation 1

Develop a more advanced prototype with greater technical capabilities

The first recommendation for future work seems to be an obvious one. To address key suggestions made by reviewers of the demonstration prototype, a more technically
advanced prototype should be developed. This would allow reviewers to assess the practical effectiveness of the tool. Such a prototype should allow reviewers to access actual live or real data. It should comprise both traditional and alternative data, and can be a selection or all data. The data should have a range of attributes attached that are appropriate to different geographic levels. The search capabilities of the demonstration prototype should be user controlled, and allow reviewers to select data using keywords and geographic attributes. They should also be able to set parameters within those search options. Ideally, the maps and map selection tool should also be an active component of the demonstration prototype. This would allow for testing of a suggestion made during the original review; that users should be able to select an area on the map and be presented with data relevant to that geographic location.

A demonstration prototype with these technical capabilities should enable reviewers to assess the practical effectiveness of the tool.

The effectiveness of the tool is ultimately the most important element. If it can be established that the GKT can successfully and efficiently present a variety of data from different sources, based on and limited by user defined keywords and parameters, the primary need is met. Other suggestions by reviewers, such as being able to personalise the tool, are second to this outcome. So, once it has been established that the tool can return relevant results based on user input, issues and ideas regarding design, layout, functionality and personalisation of the interface can be addressed.

### 7.3.2 Recommendation 2

**Apply prototype to different management areas and different geographic areas**

However, before design and user functionality issues are addressed, it is recommended that the demonstration prototype be applied to different management areas and to different geographic areas. The focus of the current prototype was data relevant to fire management and local preparations for a planned burn. Feedback suggested that a GKT could be particularly useful for different types of planning, monitoring and research activities. To test if the tool has the potential to be useful for users needing additional data, it would seem pertinent to choose management areas and user activities that would benefit from using a tool with instant access to a range of data. If it can be determined
that the GKT is useful to these users in particular, it could then be assessed as to whether it is appropriate to develop an actual tool.

The suggestion to focus on different geographic areas is based on the idea that in so doing could uncover different local data that could potentially be useful to others. This would support the overall notion that local data are relevant and need to become more easily available to a wide range of users. Additionally, it could assist in establishing the range of geographic detail and levels required. WPNP is different from some other parks in that it is a Parks Victoria district in itself, and is regarded as its own landscape (see Chapter 5.3.2). This may change the requirements for geographic detail when it is compared to a much smaller park or a park that is managed as one of a group of parks.

### 7.3.3 Recommendation 3

**Research and develop technical solutions for theoretical proposals**

If the work proposed in the first two recommendations is undertaken, and the results are positive, the next recommendation is to look into technical solutions for some of the theoretical proposals. The more technologically advanced demonstration prototype proposed in the first recommendation should already use data that are, at least partly, categorised using a range of thematic and geographic attributes. Here, it is recommended that a complete classification system is developed. The conceptual GKT listed some possibilities such as management areas, divisions and regions, departments and positions, the data type, purpose and the topics they cover. Parks Victoria systems like TRIM and ParkWeb as well as GIS data already use keywords to find data, which can form the basis for a complete classification system. Applying a systematic approach should ensure that the widest possible, most in-depth range of attributes that are applicable are incorporated. In addition to these official data attributes, users should also be able to attach personalised categories so as to make the data more appropriate to specific user needs and make them findable accordingly.

In addition to a thematic classification system, a geographic classification system is also needed. The requirement for a geographic framework was proposed in Chapter 5.6.4 to address the issue of variation in georeferencing that exists. Such a framework would have to deal not only with existing geographical structures in place at Parks Victoria
and other formal geographical hierarchies – regarded as the formal component of the geographic framework – but also with the informality of georeferencing methods found in alternative data sources and particularly in UCI contributed using collaborative tools. Again, a systematic, rigorous approach should be taken to ensure the width and depth of the framework covers different user requirements; from macro level, corporate data applicable to the whole park network to micro level, detailed data relevant to a small area or point location in a park.

Finally, considering the inclusion of alternative data, the theoretical methodology for the confidence rating system proposed by this research would need to be extended into a practical system that is technically possible. Whether a technical solution can be found for the proposed system or whether approaches applied elsewhere can be adapted to suit the GKT, users of the GKT need to be able to assess the quality and usefulness of the alternative data accessible via the tool. Such a system would provide users with a minimum level of reliability, so they have a mechanism to assess if alternative data can be used for their specific purpose and decision-making. Without a working, quality assessment system, it would be up to users themselves to assess whether the alternative data are useful at all. This would reduce the effectiveness of the GKT, although its ability to ‘find’ data using user defined parameters could still be an advantage.

Apart from research into the theoretical proposals, research can also be undertaken to find technological and practical solutions for other aspects of the GKT, such as the digitisation and annotation of both existing and alternative data and proposed functionalities. Research, developments and technologies in geographic information retrieval, geographic data mining and geographic knowledge discovery could potentially assist with finding appropriate solutions, whilst Parks Victoria could develop policies and processes for how its existing data are to be digitised.

7.3.4 Recommendation 4

Explore user contributed geographic data and crowdsourcing opportunities

Considering the results of the park visitor survey (see Chapter 5.5), a final recommendation is that exploration of the potential opportunities for gathering collective intelligence or crowdsourcing should be undertaken. Would it benefit Parks
Victoria if staff and visitors were asked to carry mobile GPS devices and collect geographic data as they travelled through the park in an attempt to enrich existing data? Can a crowdsourcing approach be used for special projects that involve the ‘crowd’ to gather important data? Or can Parks Victoria provide volunteer organisations such as Friends of the Prom with relevant tools to collect the information needed?

As mentioned in Chapter 4.5, volunteers are already collecting data and undertaking monitoring activities as part of specifically organised projects by organisations like the Victorian National Parks Association or Conservation Volunteers in collaboration with Parks Victoria and Friends groups. Can these data perhaps be collected more organically? Rather than asking people to come to the park for the specific purpose of assisting with such data collection, can regular visitors who are at the park for their own recreational purpose be asked to help collect data instead? For example, if certain information about remote areas of the park is limited, but resources (staff, time or finance) to improve this are similarly limited, could park visitors who are going to these areas be crowdsourced to collect relevant data? Such an opportunity arose in early 2012, when it was proposed that visitors to the Wilderness Zone of WPNP could assist with collecting data on the presence and locations of the Ground Parrot (Pezoporus wallicus wallicus) – a species expected to have been impacted by the area’s fire regime over the last decade (J Whelan 2012, pers. comm. 30 April). As park visitors report to staff when they intend to visit this area, the opportunity exists to ask visitors at that time to collect relevant data. The task and instructions would need to be simple, and bearing in mind that people who visit such remote areas would most likely have a keen interest in the environment and its protection, many might agree to participate. Data collected by even the relatively limited number of visitors to the Wilderness Zone would contribute to existing knowledge.

Considering that the results of the visitor survey showed that approximately 65% of park visitors could potentially participate and contribute information to assist park management, it would seem pertinent for Parks Victoria to consider such opportunities.

7.4 Knowledge systems – the next step...

There has been a gradual development of knowledge systems as outlined in Chapter 3, from Diderot's 18th century Renvois, a manual cross-reference mechanism to link articles (Zimmer 2009); the 19th century Dewey Decimal System for categorising and
thus findings books more easily (OCLC 2009); to the conceptual Memex, another antecedent of hypertext (Zimmer 2009) that would link documents based on associative relationships (Bush 1945). Berners-Lee’s World Wide Web (Berners-Lee and Fischetti 2000) made knowledge systems digital and accessible using contemporary communication systems, with related data connected through hypertext and hyperlinks. Web 2.0 allowed for collaborative notions to be incorporated, whilst geospatial technologies and the resulting growth in geographic information added a geographic element to knowledge systems. It is argued that with the growth of Web 2.0 and the GeoWeb, knowledge systems can now be both geographic and participatory. The GKT proposed by the research project is regarded to be just that: a collaborative, geographically oriented digital knowledge system. But what is next? With Web 2.0 constantly growing and evolving, can the conceptual GKT incorporate the next emergent Web development?

Arguably, there is the imminent move from Web 2.0 to Web 3.0 (with some expecting Web 4.0 to follow suit quicker than expected (Jenkins 2011; PCWorld 2008)). Web 3.0 is often referred to as the Semantic Web (Green 2009; Lassila and Hendler 2007); a Web that gives information well-defined meaning and enables people and computers to better work together (Berners-Lee, Hendler and Lassila 2001). Iskold (2007) describes it as more intelligent computing, with descriptors attached to content giving content meaning, relevance and context (Green 2009). Smart search engines will be able to deduce what these descriptors mean, and will be able to return information that is useful and relevant to the user. Instead of merely displaying data, as the Web now does, the Semantic Web will also be able to “process and “understand” the data (Berners-Lee, Hendler and Lassila 2001, p. 37).

The Semantic Web is associated with Artificial Intelligence (AI), because it is an intelligent machine that is able to represent knowledge (Lassila and Hendler 2007). While still predominantly a conceptual notion, parts of it have been developed. New technologies are sufficiently capable of incorporating semantics into Web page searches. Semantic search technology is for example being applied by Google, Microsoft’s Bing and Wolfram Alpha123 (Whitehorn 2012). Combined with the standardising of the Web Ontology Language and Resource Description Framework, two languages that power the Semantic Web, it would seem that Web 3.0 has arrived. It

will not replace the current Web, as Berners-Lee, Hendler and Lassila (2001) point out, but the Semantic Web will be an intelligent extension of it.

Web 3.0 in turn would be followed by Web 4.0, when “technology and human become one” (Müller cited in PCWorld 2008, para. 1). This integration of people and computers means people are always digitally connected through technology and devices without having to think about doing so, thus blurring the line between people and technology (PCWorld 2008).

What is being contemplated from the perspective of the research project is whether the framework for a GKT, the conceptual GKT that incorporates notions of Web 2.0, can be applied to Web 3.0. For the Semantic Web to work, structured sets of information and AI-like inference rules are required (Berners-Lee, Hendler and Lassila 2001). The GKT uses structured data that are organised by thematic and geographic keywords, essentially creating datasets that are categorised in many different ways, thus fulfilling one half of Web 3.0 requirements. Following recommendation 3 above, when finding appropriate technical solutions for theoretical proposals, an intelligent search mechanism could be the new Web 3.0 element that could be applied.

It is argued that there are already some semantic notions in the current conceptual GKT. These are found in the personalisation aspect. It was suggested that users could personalise the system based on their data requirements. By logging in to the GKT, the tool would recognise the user and present only data relevant to that user’s position and their personal data. Berners-Lee (1998) talked about the ‘correctness of search results’ and envisaged a means to sort these using ‘reasoning’, using just a few inference rules. Arguably, one of those could be instructing the computer what data are appropriate to what position. When performing a search, users would only be presented with data appropriate to that role, or relevant data could appear higher in the search results. Alternatively, instead of setting predefined data needs for user roles, users can set their own preferences and the results returned would be based on those preferences. At that moment, the GKT would arguably be ‘learning’ what the user wants.

In summary, as the Semantic Web is regarded as an extension of Web 2.0, the conceptual GKT would merely need to allow for Semantic Web technologies or capabilities to be included in the mould. It is argued that conceptual aspects of the
Semantic Web are already in the theoretical methodology for a GKT developed by the research. When researching technical solutions for an actual GKT, the potential of Web 3.0 developments should be considered so an adapted GKT could be built incorporating the latest technology. New developments related to Web 4.0 can undoubtedly be incorporated as well.

7.5 Final conclusion

In conclusion, the research project described in this thesis has developed a theoretical methodology for a GKT. It has applied participatory and collaborative concepts of Web 2.0 in order to assess if they can contribute to an effective GKT. The methodology forms the conceptual framework for building an actual GKT.

A GKT is a means to enhance access to existing georeferenced data. Additionally, it provides access to alternative data found on the Web, made available by experts and non-experts alike. This was based on the Web 2.0 notion that UCI – information contributed by users of participatory tools and broadened in scope by the research project – could potentially enhance existing information. A simple, partly interactive demonstration prototype was developed to envisage what a GKT could potentially do. The prototype was reviewed by stakeholders who gave feedback on the concept and underlying theories, as well as the overall design and usability. The results revealed that the proposed GKT could potentially become an effective tool for accessing existing georeferenced data and for finding unknown data. Additionally, having easy access to alternative data in addition to existing organisational data could benefit users that require such data for their activities.

The research project used the data archive of a park management organisation to develop the conceptual GKT and the demonstration prototype. It focused on one park and data related to fire management. However, the research’s primary outcome could be applied to areas and fields other than park and fire management. It could be applied to organisations that face similar issues to those the research project is based on, and do not use their data effectively. The notion that UCI can potentially benefit existing data is similarly applicable to other areas. Additionally, it would seem that provided the alternative data are used appropriately, and users are given a mechanism to assess the quality and usefulness of the data, the scientific rigour and professional approach to existing practices do not have to be undermined when alternative data are considered for amalgamation with traditional data.
The application of Web 2.0 into businesses was regarded to be in a relatively early phase when the research commenced, and still somewhat is, particularly in Australia. Therefore, the outcomes of this research project have contributed to insight into the opportunities of Web 2.0, the benefits that a participatory approach might bring whilst highlighting issues that might need to be considered. The ability for the theoretical methodology to be applied to different areas and fields is also regarded as a useful contribution. Further research opportunities have been proposed to better assess the potential practical effectiveness of a GKT. Additionally, technical solutions need to be researched that can be applied to the theoretical proposals put forward by the research and that were part of the conceptual GKT. Lastly, it is envisaged that the conceptual framework that has been developed can be adapted to suit the newly emerging semantic notions of Web 3.0. The conceptual GKT already incorporates some of these ideas, and being theoretical in nature, when technical solutions are sought, new developments in the Web 3.0 realm could be considered if deemed appropriate.

The research project therefore has developed a theoretical framework for a GKT for accessing georeferenced data from different sources. The framework is flexible and, when applied to develop an actual GKT, is adaptable to other areas and fields and can accommodate newly emerging concepts and technologies. The amalgamation of traditional and alternative data can potentially bring benefits to all users and assist practices and decision-making.
Research Publications and Presentations
The following list outlines the publications and presentations throughout the duration of the research project in chronological order.

Peer reviewed papers are denoted with **.


Elsley, M. & Cartwright, W. 2011, ‘Developing a methodology for a geo-knowledge tool to assist park management – a conceptual model and demonstration prototype’, paper presented to the Geospatial Science Research_1 Symposium, Melbourne, 12 – 14 December (refereed proceedings on CD-ROM).**

Elsley, M. 2012, 'Developing a methodology for a geo-knowledge tool to assist park management', School of Mathematical and Geospatial Sciences Completion Seminar, RMIT University, 20 April.
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Appendices
| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T |
| 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | 4 | 184 | Aasen, D. Van Gemen M. | Vegetation of sand dunes at Wilcannia Promontory, Victoria | Australian Journal of Botany | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 5 | 460 | Bennett T. | The Evolution of Lepidoptera population on the Yanaka Island Wilcannia Promontory, under Changes in the Burning and Grazing Regimes. Soil, chemical properties of sand, burning intervals, use of fire | Ecology Australia Pty Ltd | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 6 | 750 | Bennett Lauren T. | The Decline of Banksia Integrifolia on the Yanaka Island, Wilcannia Promontory National Park. 1993, Melbourne University, PhD | Ecology Australia Pty Ltd | A | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 1 | 7 | 5 | Carr G. | FFG nomination for Cakalawle duan Woodland as a threatened community for listing under the Flore and Fauna Guarantee Act 1992, June 2007 | Ecology Australia Pty Ltd | A | 1 | 1 | 1 | 1 | 1 |
| 1 | 8 | 563 | Chesterfield E, Turnbull-Ward A, Hoppen P, Whitem J | Early changes in vegetation from a grazing trial on Yanaka Island, Wilcannia Promontory National Park. | The Flore and Fauna Technical Report, Conservation and Natural Resources, Victoria | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 9 | 10 | Clark M | Antifea monitoring on permanent plots from Dec 2007 | Raw data | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 10 | 11 | conservation Trust Volunteers | Survey of wooded burners on the Yanaka Island, April 1992. | Raw data only: May be useful | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 12 | 2 | Cribb, P J F | The Archaeology of Wilcannia Promontory | Preliminary & Material Culture Series No. 7, Austria | A | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| 1 | 13 | J | Davies J, Costes A, Turnbull-Ward A | Ecological Vegetation Classes Mapping at 1:250,000 in Gippsland, March 2002 | Ecology Australia Pty Ltd | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 14 | 1 | Davis Naeni | Yanaka Island Herbivore Abundance Survey, 1992, 1994, 2006. Report for PIF | The University of Melbourne, Dept of Zoology | A | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 15 | 586 | Davis Naeni, Coulson Graeme, Thompson David | Data of native and introduced mammal herbivores in shrub-encroached grassy woodlands, southeastern Australia. Chap, grazing, herbivores | CSIRO, Wildlife Research, 2005, vol 35 | A | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 16 | 11 | DSE | FFG Action Statement No 103. Twelve Threatened Spider-arachnids | CSIRO, Wildlife Research, 2005, vol 35 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 17 | 17 | DSE | FFG Action Statement No 54. Leafy Greenhood, Platycoleo caucalis. Snails. | CSIRO, Wildlife Research, 2005, vol 35 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 18 | 11 | J | DSE | FFG Action Statement No. 74. New Holland Mouse. Fire intensity, season. Tea tree, habitat, monitoring | Raw data | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 19 | 16 | Ellis M | Prominent. Veg plot monitoring from December 2007. Survey | Raw data | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 20 | 762 | Godinho, Malinda | The Study of Vegetation and Soil Seed Banks to Predict Post-Fire Regeneration of Coastal Heathlands and Lepidoptera communities. Submitted in partial fulfillment of the Degree of Bachelor of Science (Honours) | School of Botany, The University of Melbourne, Australia | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 22 | J | Holland K, Nicholas S, William G | Vegetation change, fire and herbivory on Yanaka Island, Wilcannia Promontory National Park. A review prepared for Parks Victoria, March 2006 | Australian Research Centre for Urban Ecology, ARCUE | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 23 | 123 | Hope G S. | The Vegetation History from 8000 B, P. to Present of Yanaka Promontory, Victoria Australia. Cottone Lake, Fire history, sea-level, pollen analysis, analysis, Imperata, climate, peel, Darby, Nathrepe | School of Botany, University of Melbourne, February 1974, Note | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 24 | 25 | Hopmans, P | Research Report: Nutritional aspects of the decline in Banksia Integrifolia at Wilcannia Promontory National Park, Victoria. Research Report No. 395 | CSIRO, Wildlife Research and Development Branch, Forest Ser | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 25 | 766 | Iain Cole, Iain D Lunt | Reestablishing Kangaroo Grass (Themeda triandra) to grassland and woodland understory: a review of establishment requirements and restoration exercises in south-east Australia Establishment, grassland, native grasses, reseeding, Themeda triandra, understory | CSIRO, Wildlife Research and Development Branch, Forest Ser | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 26 | J | Kael, Sabine | A fornic survey of the New Holland Mouse survey plots within WIFNP. | University of Melbourne, Report for PIF | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 27 | 744 | Lachlan, Cameron W | The regeneration potential of the soil seed-bank on the Yanaka Island, Wilcannia Promontory National Park. 2007. School of Science and Engineering, University of Ballarat | Honours Thesis | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 28 | 355 | Leach Elizabeth-Anne | A Vegetation Survey of the Sand Dunes on the Yanaka Island, Wilcannia Promontory National Park, Victoria. | Masters Thesis | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
Appendix II – Summary of legislation, policies and guidelines at a state, national and international level applicable to park management


Summary of legislation, policy and guidelines
The documents most relevant to the management of Victoria’s parks and reserves are listed below.

International treaties, conventions and initiatives:
- China–Australia Migratory Birds Agreement 1986 (CAMBA)
- Japan–Australia Migratory Birds Agreement 1974 (JAMBA)
- Convention Concerning the Protection of the Natural Resources and the Environment of the South Pacific Region (SPREP Convention)
- Convention Concerning the Protection of the Natural Resources and the Environment of the South Pacific Region (SPREP Convention 1986)
- Convention on Biological Diversity
- Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)
- Guidelines for Protected Area Management Categories (IUCN World Conservation Union)
- Man and the Biosphere Program (MAP) UNESCO
- United Nations Framework Convention on Climate Change
- Convention on Wetlands of International Importance (Ramsar Convention)
- World Heritage Convention

Commonwealth legislation:
- Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cwlth)
- Civil Aviation Act 1988 (Cwlth) and sub-ordinate instruments, including Civil Aviation Orders and Fly Neighbourly Agreements
- Endangered Species Protection Act 1992 (Cwlth)
- Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act)
- Environment Protection (Impact of Proposals) Act 1974 (Cwlth)
- Historic Shipwrecks Act 1976 (Cwlth)
- Native Title Act 1993 (Cwlth)
- Quarantine Act 1908 (Cwlth)
- Telecommunications Act 1997 (Cwlth) and Low Impact Determination
- Trade Practices Act 1974 (Cwlth)

National policies and initiatives:
- Australian Alps Cooperative Management Program
• The Burra Charter
• **Caring for our Country**
• **Intergovernmental Agreement on the Environment 1992**
• **National Competition Policy**
• National Landscapes Program, Tourism Australia
• **National Strategy for Ecologically Sustainable Development (NSESD)**
• National Greenhouse Response Strategy
• Australia’s Biodiversity Strategy 2010-2030
• Strategy for Australia’s National Reserve System 2009-2030
• Wetlands Policy of the Commonwealth Government of Australia 1997

**Victorian legislation:**

• Aboriginal Heritage Act 2006 (Vic.)
• Catchment and Land Protection Act 1994 (Vic.)
• Charter of Human Rights and Responsibilities Act 2006 (Vic.) (“the Charter”)
• Coastal Management Act 1995(Vic.)
• Conservation, Forests and Lands Act 1987 (Vic.)
• Crown Land (Reserves) Act 1978 (Vic.)
• Emergency Management Act 1986 (Vic.)
• Environmental Effects Act 1978 (Vic.)
• Environment Protection Act 1970 (Vic.), including State Environment Protection Policies (Waters of Victoria) and its schedules
• Fences Act 1968 (Vic.)
• Flora and Fauna Guarantee Act 1988 (Vic.)
• Fisheries Act 1995 (Vic.)
• Forests Act 1958 (Vic.)
• Heritage Act 1995(Vic.)
• Heritage Rivers Act 1992(Vic.)
• Interpretation of Legislation Act 1984 (Vic.)
• Land Act 1958 (Vic.)
• Land Acquisition and Compensations Act 1986 (Vic.)
• Land Conservation (Vehicle Control) Act 1972 (Vic.)
• Land Conservation (Vehicle Control) Regulations 2003 (Vic.)
• Livestock Disease Control Act 1994 (Vic.)
• Marine Act 1988 (Vic.)
• Mineral Resources (Sustainable Development) Act 1990 (Vic.)
• Museums Act 1983 (Vic.)
• National Parks Act 1975 (Vic.)
• National Park (Park) Regulations 2003 (Vic.)
• Occupational Health and Safety Act 1985 (Vic.)
• Parks Victoria Act 1998 (Vic.)
• Petroleum Act 1998 (Vic.)
• Petroleum (Submerged Lands) Act 1982 (Vic.)
• Pipelines Act 2005 (Vic.)
• Port Services Act 1995 (Vic.)
• Port Services (Local Ports) Regulations 2004 (Vic.)
• Reference Areas Act 1978 (Vic.)
• Road Safety Act 1986 (Vic.)
• Road Management Act 2004 (Vic.)
• Subordinate Legislation Act 1994 (Vic.)
• Traditional Owner Settlement Act 2010(Vic.)
• Transfer of Land Act 1958 (Vic.)
• Water Act 1989 (Vic.)
• Wildlife Act 1975 (Vic.)
• Wildlife (Marine Mammal) Regulations 2009 (Vic.)
• Wrongs Act 1958 (Occupiers Liability Act 1983) (Vic.)

**Victorian policies and strategies:**

• A Fairer Victoria (DPCD 2010)
• Growing Victoria Together (2001)
• Guidelines and Procedures for Managing Environmental Impacts of Weeds on Public Land in Victoria (DSE 2007)
• Invasive Plant and Animal Policy Framework (IPAPF) (DSE 2009)
• Linking People and Spaces (Parks Victoria 2002)
• Living with Fire: Victoria’s Bushfire Strategy (2008)
• Melbourne 2030
• Policy for Sustainable Recreation and Tourism on Victoria’s Public Land (DSE 2002)
• Regulatory Impact Statement Handbook
• Securing Our Natural Future: a white paper for land and biodiversity at a time of climate change (DSE 2009)
• Victoria’s Biodiversity Strategy
• Victoria’s Heritage – Strengthening our Communities (State of Victoria 2006)
• Victoria’s Nature-based Tourism Strategy 2008-12 (Tourism Victoria 2008)
• Victorian Coastal Strategy (DSE 2008)
• Victorian Marine Pollution Contingency Plan (VICPLAN) (MSV 2002)
• Victorian Native Title Settlement Framework
• Victorian River Health Strategy (DSE 2002)
• Waste Management Policy (Ship’s Ballast Water) (EPA 2004)

**Parks Victoria strategies:**

• Conservation Reserves Management Strategy (Parks Victoria 2003)
• Guidelines for Working with Aboriginal Communities (Parks Victoria 2002)
• Heritage Management Strategy (Parks Victoria 2003)
• Indigenous Partnership Strategy and Action Plan (Parks Victoria 2005)
• Linking People and Spaces (Parks Victoria 2002)

**Codes of Practice:**

National and State Codes of Practice have been developed on a range of matters, and may be voluntary or statutory in nature. Some codes relevant to the management and administration of parks and reserves are listed below.

• Animal Welfare (various)
• Beekeeping Code of Practice
• Code of Practice for Fire Management on Public Land (DSE 2006)
• Code of Practice for Powerline Clearance (Vegetation)
• Code of Practice for Telecommunications Infrastructure (Cwlth)
Appendix III – Overview of key and background data encountered during the investigation into fire management data requirements

The following table depicts the core of the key and background fire management data stored, utilised or required. It includes documents previously described in Chapter 5.2, the background data used to develop some of these key fire management documents as well as data that are mentioned in these documents but are not necessarily used. If the data were applicable to a particular document, such as the FEA or a burn plan, this is also listed.

<table>
<thead>
<tr>
<th>Data requirements</th>
<th>Required for</th>
</tr>
</thead>
<tbody>
<tr>
<td>A current (actual) age-class distribution graph for each Ecological</td>
<td>FEA</td>
</tr>
<tr>
<td>Vegetation Class (EVC)</td>
<td></td>
</tr>
<tr>
<td>A current spatial age-class distribution for each EVC</td>
<td>FEA</td>
</tr>
<tr>
<td>Action for Biodiversity Conservation</td>
<td></td>
</tr>
<tr>
<td>Actual v. theoretical age-class distribution graphs for each EVC</td>
<td>FEA</td>
</tr>
<tr>
<td>Advisory list of rare and threatened plants in Victoria</td>
<td></td>
</tr>
<tr>
<td>Argos</td>
<td></td>
</tr>
<tr>
<td>Arthur Rylah Institute Technical report</td>
<td>EAP</td>
</tr>
<tr>
<td>Bark fuel</td>
<td>SRP</td>
</tr>
<tr>
<td>Biodiversity Strategy</td>
<td></td>
</tr>
<tr>
<td>BioMap</td>
<td></td>
</tr>
<tr>
<td>Bioregional Network Data</td>
<td></td>
</tr>
<tr>
<td>Bioregions</td>
<td>EAP</td>
</tr>
<tr>
<td>Broad fuel categories (dry forest, damp forest, tall closed shrubland,</td>
<td>SRP</td>
</tr>
<tr>
<td>heathland)</td>
<td></td>
</tr>
<tr>
<td>Broad management aims</td>
<td>FEA</td>
</tr>
<tr>
<td>Broad Vegetation Types</td>
<td>EAP</td>
</tr>
<tr>
<td>Candidate Burn Area Maps</td>
<td></td>
</tr>
<tr>
<td>Code of Practice for Fire Management on Public Land (2006)</td>
<td>FEA</td>
</tr>
<tr>
<td>Comprehensive fire ecology monitoring manual (under development)</td>
<td>FEA</td>
</tr>
<tr>
<td>Consultant reports</td>
<td>EAP</td>
</tr>
<tr>
<td>Dataset with min/max fire interval for individual species and groups of EVCs</td>
<td>FEA</td>
</tr>
<tr>
<td>Draft Conservation Strategy for WPNP - northern end (Chesterfield and Whelan 1995)</td>
<td>EAP</td>
</tr>
<tr>
<td>Draft explanatory guide for undertaking quantitative regional and state analysis</td>
<td>EAP</td>
</tr>
<tr>
<td>of environmental values of parks</td>
<td></td>
</tr>
<tr>
<td>Draft post-fire monitoring protocols (WPNP)</td>
<td>FEA</td>
</tr>
<tr>
<td>Draft protocol for assessment of vegetation condition</td>
<td>EAP</td>
</tr>
<tr>
<td>Elevated fuel</td>
<td>SRP</td>
</tr>
<tr>
<td>Emergency Management Manual Victoria</td>
<td></td>
</tr>
<tr>
<td>Environmental Information System</td>
<td></td>
</tr>
<tr>
<td>EVCs</td>
<td>EAP / FEA</td>
</tr>
<tr>
<td>Fire and biodiversity research projects</td>
<td></td>
</tr>
<tr>
<td>Fire Ecology Analysis tool (GIS based)</td>
<td></td>
</tr>
<tr>
<td>Fire Ecology Assessment WPNP (2007)</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Source</td>
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<tr>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>Fire or Fuel Management Zones</td>
<td>FEA</td>
</tr>
<tr>
<td>FireWeb</td>
<td></td>
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<tr>
<td>Flora and Fauna Guarantee Act 1988 action statements</td>
<td>EAP</td>
</tr>
<tr>
<td>Flora Information System</td>
<td>EAP / FEA</td>
</tr>
<tr>
<td>Fuel moisture data</td>
<td>SRP</td>
</tr>
<tr>
<td>Fuel types - distribution and levels</td>
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<tr>
<td>Gippsland FPP</td>
<td>FEA</td>
</tr>
<tr>
<td>Ground inspection of candidate burn areas</td>
<td></td>
</tr>
<tr>
<td>History of ecological burns</td>
<td>EAP / FEA</td>
</tr>
<tr>
<td>History of prescribed fires</td>
<td>EAP / FEA</td>
</tr>
<tr>
<td>History of wildfires</td>
<td>EAP / FEA</td>
</tr>
<tr>
<td>Indication of burn intensity (postburn) = Forest Fire Danger Indices</td>
<td>BP</td>
</tr>
<tr>
<td>Key database with fire history</td>
<td>FEA</td>
</tr>
<tr>
<td>Key database with species life history</td>
<td>FEA</td>
</tr>
<tr>
<td>Key Fire Response Species</td>
<td>FEA</td>
</tr>
<tr>
<td>Land Conservation Council reports</td>
<td>EAP</td>
</tr>
<tr>
<td>Land Management Units</td>
<td>FEA</td>
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<td>Management zones</td>
<td>FEA</td>
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<tr>
<td>Minimum and maximum tolerable Fire Intervals</td>
<td>FEA</td>
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<tr>
<td>Model to establish rate of fuel re-accumulation and overall fuel hazard (linear and non-linear regression techniques)</td>
<td>SRP</td>
</tr>
<tr>
<td>Monitoring protocol and proforma (developed by Tolhurst)</td>
<td>FEA</td>
</tr>
<tr>
<td>Near surface fuels</td>
<td>SRP</td>
</tr>
<tr>
<td>Overall Fuel Hazard Guide (1999 McCarthy et al)</td>
<td>SRP</td>
</tr>
<tr>
<td>ParkView</td>
<td></td>
</tr>
<tr>
<td>Prescribed burning estimates for each EVC</td>
<td>FEA</td>
</tr>
<tr>
<td>Prescribed or individual Burn Plans</td>
<td></td>
</tr>
<tr>
<td>Protected areas</td>
<td>EAP</td>
</tr>
<tr>
<td>Recorded heritage sites</td>
<td>FEA</td>
</tr>
<tr>
<td>Research</td>
<td></td>
</tr>
<tr>
<td>Scoring system</td>
<td>SRP</td>
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<tr>
<td>Significant Sites Register</td>
<td>G&amp;P</td>
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<tr>
<td>Site specific surveys</td>
<td>EAP</td>
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<tr>
<td>South Gippsland FOP</td>
<td></td>
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<tr>
<td>Spatial age-class distribution maps for each EVC</td>
<td>FEA</td>
</tr>
<tr>
<td>Specific ecological fire management objectives</td>
<td>FEA</td>
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<tr>
<td>Surface fine fuel</td>
<td>SRP</td>
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<tr>
<td>Tacit/expert knowledge</td>
<td>EAP</td>
</tr>
<tr>
<td>Theoretical age-class distribution</td>
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<tr>
<td>Theses (PhD, Masters, Honours)</td>
<td>EAP</td>
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<tr>
<td>Victorian Naturalist issues</td>
<td>EAP</td>
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<tr>
<td>Victorian Overview to District Fire Operations Planning 2009-10 to 2011-12</td>
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<tr>
<td>Vital attribute data</td>
<td>FEA</td>
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<tr>
<td>Weather</td>
<td></td>
</tr>
<tr>
<td>Wildlife Atlas</td>
<td>EAP</td>
</tr>
<tr>
<td>WPNP Environmental Action Plan 2003</td>
<td></td>
</tr>
<tr>
<td>WPNP Management Plan (2002)</td>
<td></td>
</tr>
<tr>
<td>WPNP Management Plan 1987 (by Department of Conservation, Forests and Land)</td>
<td>EAP</td>
</tr>
<tr>
<td>• a list or attachments identifying people who must be notified prior to and on the day of the burn, such as neighbours, other agencies, licensed forest operators etc.</td>
<td>BP</td>
</tr>
</tbody>
</table>
- a version and date stamp  
- any contingency areas  
- any Departmental burn prescriptions (Regional and other) prepared in accordance with the Code of Practice and other relevant Departmental policies, standards and guidelines  
- any major variations to quantity/condition in target fuel that may lead to significantly different fire behaviours or endanger security of the control lines, e.g. areas of heath (zones which combine areas with similar fuel type, slope and aspect may be identified and mapped for the Burning Unit)  
- any other assets and values requiring protection during the burn (such as fences or buildings on adjoining private property or beehives or regenerating areas on public land)  
- any other constraints, including timing; cultural sites of significance  
- any significant values, in particular ecological issues, including the known or likely presence of very rare or threatened fire-sensitive species or communities in or near the Burning Unit, particular habitats needing protection, sensitive life-stages of species, any known local events such as heavy budding, flowering or seeding of trees or other plants which may influence the timing of the burn (map where appropriate)  
- any smoke management considerations including any measures required to minimise undue impacts on townships and other sensitive areas  
- any special measures to be taken to protect identified values  
- any special provisions (such as for burns adjacent to significant private or public assets)  
- any special rehabilitation required on completion of the burn  
- any specific areas within the control lines from which fire is to be excluded  
- any traffic and public management arrangements, including signs on access routes to the area advising of the conduct of burning and of potential smoke  
- appropriate MGA (Map Grid Australia) grid reference (Easting and Northing)  
- area to be burned  
- area to be burnt  
- burn location and burn grid reference  
- burn name and number  
- dominant vegetation type (map any major variations that may affect fire behaviour)  
- escape routes  
- fall-back control lines  
- fire history: when the Burning Unit and surrounding area was last burned (if known) and by what type of fire (map any boundaries where fire behaviour may vary significantly)*  
- Fire Management Zone  
- hazardous areas or areas excluded for safety reasons (this must be included)  
- ignition method and lighting pattern  
- land tenure and use  
- limits to acceptable fireline intensity for the burn (see Chapter 5 of this manual) or the need to avoid excessive scorch  
- location of signs advising of the conduct of burning and, where appropriate, of potential reduction in visibility caused by smoke  
- location of the nearest available water supplies  
- maps (should include the following)  
- nomination of the Officer in Charge of the Burn (Burn OIC)
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-target fuels / adjacent assets within 500m of the Burning Unit</td>
<td>e.g. houses, plantation, crop etc.</td>
</tr>
<tr>
<td>north point</td>
<td>BP</td>
</tr>
<tr>
<td>objectives of the burn</td>
<td>BP</td>
</tr>
<tr>
<td>particular safety measures to be observed on- and off-site</td>
<td>BP</td>
</tr>
<tr>
<td>perimeter control lines</td>
<td>BP</td>
</tr>
<tr>
<td>potential containment problems</td>
<td>BP</td>
</tr>
<tr>
<td>pre- and post-burn survey requirements, if appropriate (for prescribed burns other than for fire protection)</td>
<td>BP</td>
</tr>
<tr>
<td>refuge and meeting points</td>
<td>BP</td>
</tr>
<tr>
<td>relevant soil and catchment issues</td>
<td>BP</td>
</tr>
<tr>
<td>resource levels appropriate to manage the burn under the prescribed conditions, including that required for worse-than-prescribed conditions;</td>
<td>BP</td>
</tr>
<tr>
<td>scale</td>
<td>BP</td>
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<tr>
<td>season of the burn (and anticipated date)</td>
<td>BP</td>
</tr>
<tr>
<td>the acceptable limits of weather and fuel prescriptions for the burn</td>
<td>BP</td>
</tr>
<tr>
<td>topographical feature</td>
<td>BP</td>
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<tr>
<td>type of burn (such as fuel reduction, ecological, regeneration)</td>
<td>BP</td>
</tr>
<tr>
<td>type of, and distance to, nearest asset</td>
<td>BP</td>
</tr>
<tr>
<td>types of control lines</td>
<td>BP</td>
</tr>
<tr>
<td>vehicular tracks and roads within and in the vicinity of the Burning Unit, particularly those to be used as controls during the burn or in case of escape, and including those which are to be closed during the operation</td>
<td>BP</td>
</tr>
<tr>
<td>where relevant, slopes within and adjacent to the Burning Unit that would impact significantly on fire behaviour</td>
<td>BP</td>
</tr>
</tbody>
</table>

BP = Burn Plan (also identified with • preceding the item)
FEA = Fire Ecology Assessment
EAP = Ecological Action Plan
SRP = Special fire research project currently underway at WPNP
Appendix IV – Selection of key and background data encountered during the investigation into fire management data requirements reorganised by type

Rearrangement of the data listed in Appendix V by type – from paper documents to GIS files, databases and maps as well as digital information systems in place. The items identified as requirements for a burn plan have been omitted.

<table>
<thead>
<tr>
<th>Paper only (highly likely)</th>
<th>Paper and digital (highly likely)</th>
<th>Databases / Information systems</th>
<th>GIS layers</th>
<th>Maps</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPNP Management Plan 1987 (by Department of Conservation, Forests and Land)</td>
<td>Overall Fuel Hazard Guide (1999 McCarthy et al)</td>
<td>Argos</td>
<td>Protected areas</td>
<td>Ecological Vegetation Classes</td>
<td>History of wildfires (e.g. historic societies, fire reports)</td>
</tr>
<tr>
<td>Land Conservation Council reports</td>
<td>Indication of burn intensity (postburn) = Forest Fire Danger Indices</td>
<td>Flora Information System</td>
<td>Broad Vegetation Types</td>
<td>Recorded heritage sites</td>
<td>History of prescribed fires (e.g. historic societies, fire reports)</td>
</tr>
<tr>
<td>Draft protocol for assessment of vegetation condition</td>
<td>Theses (PhD, Masters, Honours)</td>
<td>Vital attribute data</td>
<td>Bioregions</td>
<td>Candidate Burn Area Maps</td>
<td>History of ecological burns (e.g. historic societies, fire reports)</td>
</tr>
<tr>
<td>Draft Conservation Strategy for WPNP - northern end (Chesterfield and Whelan 1995)</td>
<td>WPNP Environmental Action Plan 2003</td>
<td>Key database with species life history</td>
<td>Land Management Units</td>
<td></td>
<td>Theoretical age-class distribution</td>
</tr>
<tr>
<td>Victorian Naturalist (is to be digitised)</td>
<td>Victorian Overview to District Fire Operations Planning 2009-10 to 2011-12</td>
<td>Key database with fire history</td>
<td>Recorded heritage sites</td>
<td></td>
<td>Tacit/expert knowledge</td>
</tr>
<tr>
<td>Fire and biodiversity research projects</td>
<td>South Gippsland FOP</td>
<td>Dataset with min/max fire interval for individual species and groups of Ecological Vegetation Classes</td>
<td>Candidate Burn Areas</td>
<td>Surface fine fuel</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>Draft post-fire monitoring protocols (WPNP)</td>
<td>Prescribed or individual Burn Plans</td>
<td>BioMap</td>
<td>Management zones</td>
<td>Site specific surveys</td>
<td></td>
</tr>
<tr>
<td>Monitoring protocol and proforma (developed by Tolhurst)</td>
<td>InfoWeb</td>
<td>Wildlife Atlas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gippsland FPP</td>
<td>ParkView</td>
<td>History of prescribed fires</td>
<td></td>
<td>Scoring system</td>
<td></td>
</tr>
<tr>
<td>Emergency Management Manual Victoria</td>
<td>Fire Ecology Analysis tool (GIS based)</td>
<td>Advisory list of rare and threatened plants in Victoria</td>
<td></td>
<td>Model to establish rate of fuel re-accumulation and overall fuel hazard (linear and non-linear regression techniques)</td>
<td></td>
</tr>
<tr>
<td>Comprehensive fire ecology monitoring manual (under development)</td>
<td>Internet</td>
<td>Fire or Fuel Management Zones</td>
<td></td>
<td>Fuel moisture data</td>
<td></td>
</tr>
<tr>
<td>Code of Practice for Fire Management on Public Land (2006)</td>
<td></td>
<td>Other GIS layers derived during FEA process</td>
<td></td>
<td>Elevated fuel</td>
<td></td>
</tr>
<tr>
<td>Biodiversity Strategy</td>
<td></td>
<td></td>
<td>Broad fuel categories (dry forest, damp forest, tall closed shrubland, heathland)</td>
<td></td>
<td></td>
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<td>-----------------------</td>
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<td>--------------------------------------------------------------------------------</td>
<td></td>
<td></td>
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<tr>
<td>Consultant reports</td>
<td></td>
<td></td>
<td>Bark fuel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthur Rylah Institute Technical reports</td>
<td></td>
<td></td>
<td>Research</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix V – Confirmation of Ethics Approval to conduct a park visitor survey at WPNP

24th November

Monique Eldey
School of Mathematical and Geospatial Sciences
RMIT University
Building 12, Level 11, Room 7
City Campus

Dear Monique,

BSETAPP 46 – 09 ELSLEY The development of an integrated media geo-knowledge tool in the natural environments domain, incorporating Web 2.0 applications

Thank you for submitting your amended application for review.

I am pleased to inform you that the Science, Engineering & Health College Human Ethics Advisory Network (CHEAN) has approved your application for a period of 12 Months to December 2010 and your research may now proceed. The CHEAN considers this to be a Low Risk (formerly Level 2) proposal.

The CHEAN would like to remind you that:

All data should be stored on University Network systems. These systems provide high levels of manageable security and data integrity, can provide secure remote access, are backed up on a regular basis and can provide Disaster Recover processes should a large scale incident occur. The use of portable devices such as CDs and memory sticks is valid for archiving; data transport where necessary and for some works in progress.

The authoritative copy of all current data should reside on appropriate network systems; and the Principal Investigator is responsible for the retention and storage of the original data pertaining to the project for a minimum period of five years.

Annual reports are due during December for all research projects that have been approved by the College Human Ethics Advisory Network (CHEAN).

The necessary form can be found at: http://www.rmit.edu.au/governance/committees/hoc

Yours faithfully,

Indu Singh
Chair, Science Engineering & Health
College Human Ethics Advisory Network ‘B’

Cc: CHEAN Members: Zhen Zhang & George Lassen, School of Health Sciences
Supervisor: Colin Arrowsmith, School of Mathematical and Geospatial Sciences
William Cartwright, School of Mathematical and Geospatial Sciences
Appendix VI – Park visitor survey questions

Visitor Survey

*Please ensure you have read the attached project information sheet before answering this questionnaire.*

Please check applicable box(es). Please note that where appropriate, you may check multiple boxes that apply.

**General**

1) What is your age group?
   - □ 18-30
   - □ 31-45
   - □ 46-60
   - □ >60

2) What is your gender?
   - □ Female
   - □ Male

3) Do you use the Internet?
   - □ No
   - □ Yes

   If no, please proceed to question 5). Please also note that some questions in this questionnaire may not apply to you. Please simply skip these questions or complete them if you can (for example if your ‘ideas’ are asked about rather than your actual ‘experience’)

   If you do use the Internet, are you aware of or familiar with the Web 2.0 applications or products described in the introductory letter?
   - □ No
   - □ Yes

   If no, please note that some questions in this questionnaire may not apply to you. Please simply skip these questions or complete them if you can (for example if your ‘ideas’ are asked about rather than your actual ‘experience’)

   If yes, which of the following, if any, do you use?
   - □ None
   - □ Blogs
   - □ Wikis
   - □ Feedback forums
   - □ Twitter
   - □ YouTube
   - □ Facebook
   - □ Flickr
   - □ Other, please specify _____________________________________________

4) Do you use the Internet on mobile devices like a mobile phone or Personal Digital Assistant (PDA)?
   - □ No
Yes
If no, please proceed to question 5)
If yes, please specify which mobile device(s) ____________________________
If yes, is/are your mobile device(s) Wi-Fi (wireless) enabled?
☐ No
☐ Yes
☐ Not sure

5) Please tick all boxes that apply. What type of information in relation to Wilsons Promontory, or parks in general, are you interested in?
☐ None in particular
☐ Nature (flora/fauna)
☐ Hiking/trails (more than 1 day)
☐ Bushwalking/short walks (1 day or less)
☐ Natural/geographic features such as waterfalls, lookouts etc.
☐ Cultural features, such as historic sites, aboriginal sites, art etc.
☐ Watersports such as surfing, fishing, kayaking, diving etc.
☐ Camping
☐ Other, please specify ____________________________

About Web 2.0

6) What is your opinion on the concept of Web 2.0, that people can communicate and share information with others via the Web using these special tools and websites? Do you find the idea:
☐ Interesting
☐ Fun
☐ Useful (e.g. saves time, can be done at any time, even when the other person is out)
☐ ‘Exaggerated’ (e.g. what is wrong with the phone or visiting someone; why post messages or photos on the web?)
☐ Waste of time / Don’t see the point
☐ Intrusive (e.g. people ask for or give too much information, or too often)
☐ Just part of the latest trend – no doubt it will pass
☐ Perhaps more for the younger generation, or at least not for me
☐ I have no opinion / don’t care
☐ Other, please specify ____________________________

For the next two questions, please tick the box that best represents your general thoughts or feelings:

7) I feel that participating and collaborating on the Web can be dangerous - who knows how other will ‘reuse’ what is being written or posted.

☐ ☐ ☐ ☐ ☐ ☐
Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree
8) If I were to contribute information to Web 2.0 websites myself, this information would be of such a nature that I wouldn’t mind it being used or passed on by others.

- [ ] Strongly disagree
- [ ] Disagree
- [ ] Neither agree nor disagree
- [ ] Agree
- [ ] Strongly agree

9) Would you be happy to upload selected (by you) non-personal photos or films you have taken during your stay here at the park onto a photo or video sharing website, so that other people can enjoy them?

- [ ] Yes, and any photo sharing site would be fine
- [ ] Yes, but only if it is a special dedicated website to Parks Victoria or Wilsons Prom
- [ ] Yes, but only if it was made easy for me to do so (e.g. a computer was ready in the Visitors Centre)
- [ ] Yes, I would be happy to do so from home
- [ ] Perhaps, I would have to think about that / get more information
- [ ] No, I don’t think so
- [ ] Other, please clarify ______________________________________________

10) If Wilsons Promontory were to use Web based communication tools, such as a blog, feedback forum, Twitter, or a photo sharing space, do you think you would use these tools?

- [ ] Yes, I would probably participate as much as I could, e.g. provide feedback, upload photos etc.
- [ ] Yes, but I would probably only look at other people’s comments and photos (i.e. not necessarily contribute myself)
- [ ] Perhaps, I would have to think about that / get more information
- [ ] No, I don’t think so (please proceed to question 12)
- [ ] Other, please clarify ______________________________________________

11) If you were to use those tools, how often do you think you might be doing so?

- [ ] Probably only after a visit to The Prom
- [ ] Probably regularly, at least once a week
- [ ] Maybe at least a few times a month
- [ ] Perhaps a few times a year
- [ ] Probably once or twice and then no more

12) Do you have a GPS enabled mobile phone or other GPS enabled mobile device like a PDA?

- [ ] Yes
- [ ] No

13) If Parks Victoria provided you with a mobile GPS enabled device, would you be happy to have your movements ‘tracked’ during (part of) your stay, to assist research into park use?

- [ ] Yes, but only if I didn’t have to do anything for it (except carry it)
- [ ] Yes, even if this required some input from me, such as pressing a button every now and then or taking photos
- [ ] No, I don’t think so
User experience/information needs

14) Do you usually find information about a place that you visit?
   ■ No
   ■ Yes
   If no, please proceed to question 15)

   If yes, how do you usually obtain this information?
   ■ Guidebook / other books
   ■ Beforehand, from the Internet
   ■ Beforehand, through brochures and/or information from a tourist centre
   ■ At destination, through brochures and/or information from visitor centre
   ■ At destination, by accessing Internet on a mobile device
   ■ Other, please specify ____________________________________________

15) If there was a Web tool that let you choose the information you were interested in and put it together as a map or other document to take with you, how likely is it that you would utilise this Web tool instead of e.g. an existing guidebook or brochure?
   ■ Definitely
   ■ Very likely
   ■ Perhaps, I would have to think about that / get more information
   ■ Probably not
   ■ No

16) Do you use maps?
   ■ Yes
   ■ No
   If no, please proceed to the final questions under ‘About your stay at Wilsons Promontory’.

17) What are your general views in relation to maps and the information on them?
   ■ Maps normally show a variety of information, most of it useful
   ■ Maps normally show a variety of information, but only some of it is what I am after
   ■ I wish I could take a map that would only show information that is important to me
   ■ Maps are useful on their own; the symbols used help me understand what things are
   ■ Maps are better if they are combined with other information, for example, with a brochure that explains things in writing
   ■ I don’t think that maps are that useful; brochures or information sheets are much more useful
   ■ I have no particular opinion
   ■ Other, please clarify ____________________________________________
About your stay at Wilsons Promontory

What main activity/activities did/will you undertake? ____________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

If applicable, please briefly describe how you enjoyed/experienced the activity.____
_____________________________________________________________________________________
_____________________________________________________________________________________

During your stay at Wilsons Promontory, was/is there any additional information you wish you had?
☑ No
☐ Yes
If yes, please clarify _________________________________________________________________

Do you have any other suggestions or comments? __________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Thank you for your time and assistance!
Appendix VII – Park visitor survey explanatory letter or Plain Language Statement

The front and back page of the explanatory letter provided to park visitors that took place in the visitor survey at WPNP.

Dear Participant,

My name is Monique Elsley and I am a PhD candidate in the School of Mathematical and Geospatial Sciences at RMIT University. The research is titled “The development of an integrated media geo-knowledge tool in the natural environments sector, incorporating Web 2.0 and other Web-based technologies”, and is undertaken under the supervision of Professor William Cartwright and Associate Professor Colin Arrowsmith from Geospatial Sciences.

The research is being conducted in collaboration with Parks Victoria, and Wilsons Promontory National Park is the study area. One of the aims of the geo-knowledge tool is to improve park management, and we think it is important to include feedback from visitors to the park, hence my being here today to ask for your assistance.

Project background and description

Parks Victoria possesses a vast amount of data relating to its parks that are stored in different locations. We aim to develop and test a geo-knowledge tool (a geographically oriented digital information system) that will make access to all this data easy and effective and appropriate to user needs (for example a visitor to the park, a park ranger or Parks Victoria manager). This project will investigate if this access can be provided, in part, using Web 2.0 and other Web tools that have recently emerged and are growing in use.

Web 2.0 refers to Web applications that focus on user participation and collaboration. People can upload photos or videos, interact with each other and share information. Examples of popular Web 2.0 tools include YouTube (video-sharing), Facebook (social networking), and Twitter (micro-blogging). GoogleMaps and GoogleEarth are examples of Web tools that let users display their information geographically. The geo-knowledge tool will apply these tools so that Parks Victoria staff and visitors can participate and collaborate.

We will also investigate how Web 2.0 can capture new data, including new information and knowledge resulting from staff and visitor participation and collaboration. If this can be captured and fed back into the geo-knowledge tool, it has the potential to improve or enrich existing data such as that already owned by Parks Victoria. This should ultimately benefit all users of the data and may help better manage parks.

Survey

We would like your participation in this survey to:
- Identify what you value from your trips to parks such as Wilsons Promontory National Park;
- Determine the general attitude of park visitors towards new technologies to participate and share information;
- Investigate how information that park visitors may possess could potentially benefit Parks Victoria and other visitors to the park and fill information gaps; and
- Assess what your preferred methods are to access and view information.

The findings from the survey will guide us in the best ways to develop and build a geo-knowledge tool that is appropriate and effective, so that visitors to Wilsons Promontory, such as yourself, can access relevant information that you are interested in, in formats that are useful, through appropriate Web tools.

The survey consists of 17 main multiple choice questions divided into three areas: general, Web 2.0 and user information needs, and a few final ‘open’ questions relating to your visit to Wilsons Promontory today. The survey should take around 10 minutes to complete. We understand your time here at the park is for your leisure, but we truly value your feedback and assistance with this survey and hope that it will ultimately benefit yourself at some point in the future.
Possible risks and benefits
We perceive there to be no actual risk to you in completing this questionnaire. Similarly, there is not necessarily a direct, personal benefit either, however, as a visitor to Wilsons Promontory and therefore a potential future user of their data, our findings may assist you in future in accessing better, relevant information to you.

Privacy and disclosure of information
The data collected in this survey will be analysed and aggregated for publishing in a PhD thesis and professional journals, and for presentations at conferences. The data will be generalised, maintaining your anonymity. Individual responses will not be identified. After the research is complete, all survey responses will be stored for five years in a secure facility at RMIT, after which they will be destroyed.

Please note that your involvement in this survey is entirely voluntarily and you may withdraw from it at any time, simply by stopping the completion of the questionnaire. This survey has received clearance to be undertaken from the RMIT Human Research Ethics Committee.

Contact
If you have any questions regarding this project, please feel free to either contact myself or one of my RMIT supervisors.

Thank you for your time.

Monique Elsley BAppSc (Multimedia Cartography) BAppSc (Geospatial Sc) (Hons)
PhD Candidate
Email: monique.elsley@student.rmit.edu.au
Ph: (03) 9925 3277

Prof William Cartwright PhD EdD FRGS FBCartS HonFMSIA HonFSSI
Professor of Cartography and Geographical Visualization
Email: william.cartwright@rmit.edu.au
Phone: (03) 9925 2423

Assoc Prof Colin Arrowsmith BSurv MSurvSc MEnvS (Melb) GradDipEd PhD (RMIT) FRGS
Email: colin.arrowsmith@rmit.edu.au
Phone: (03) 9925 2042

School of Mathematical and Geospatial Sciences
RMIT University
GPO Box 2476V
Melbourne Victoria 3001

Any complaints about your participation in this project may be directed to the Executive Officer, RMIT Human Research Ethics Committee, Research & Innovation, RMIT, GPO Box 2476V, Melbourne VIC 3001. The telephone number is (03) 9925 2251.
Appendix VIII – Conceptual model of the GKT in broad terms, based on Parks Victoria and fire management in general
Appendix IX – Conceptual model of the GKT focussing on WPNP and planned ecological burning

Conceputal model of a geo-knowledge tool with a focus on the management of planned fire and Wilsons Promontory National Park (WPNP)

Ronique Olayo, PhD Candidate, RMIT University - April 2021 (Version 2)

Wiki management

Unburned fire

Ecological fire management

Fast reduction

Pre-separation

NATIONAL PARKS ACT 1975, FOREST ACT 1958, NATIONAL PARKS ACT 1975 (NSW), NATIONAL PARKS ACT 1975 (ACT), NATIONAL PARKS ACT 1975 (QLD), NATIONAL PARKS ACT 1975 (WA), NATIONAL PARKS ACT 1975 (TAS), REMARKABLE PARKS ACT 1988 (TAS), RESEARCH AND SCIENTIFIC ACT 1950 (NSW), RESEARCH AND SCIENTIFIC ACT 1950 (QLD), RESEARCH AND SCIENTIFIC ACT 1950 (WA), RESEARCH AND SCIENTIFIC ACT 1950 (ACT), RESEARCH AND SCIENTIFIC ACT 1950 (TAS), PROTECTIVE FOREST MANAGEMENT ACT 1991 (NSW), LEGISLATION, LANDS ACT, OTHERS.

Action Statement

NATIONAL PARKS ACT 1975 (NSW), FOREST ACT 1958 (NSW), NATIONAL PARKS ACT 1975 (ACT), NATIONAL PARKS ACT 1975 (QLD), NATIONAL PARKS ACT 1975 (WA), NATIONAL PARKS ACT 1975 (TAS), REMARKABLE PARKS ACT 1988 (TAS), RESEARCH AND SCIENTIFIC ACT 1950 (NSW), RESEARCH AND SCIENTIFIC ACT 1950 (QLD), RESEARCH AND SCIENTIFIC ACT 1950 (WA), PROTECTIVE FOREST MANAGEMENT ACT 1991 (NSW), LANDS ACT, OTHERS.

Key regulatory

Key documents

Victoriaan Government

International agencies

Key Australian legislation

Statutory policies, strategies and guidelines

Radio Networks

Emerging data / innovation

Data through the tool

Existing data / innovation

New data

Existing data

Findings

Web 2.0 tools

Social media and collaboration

Organisational websites

Special projects

At WPNP

Specific data of any kind

Specific data of any kind

Facebook

Twitter

Staff, visitors and general public

User insights

Possible tools

Facebook

Google

YouTube

Twitter

Favourites

Maps

Pagers, SMS, etc.

Facebook, YouTube and others were the applications most used by visitors to WPNP according to a mobile survey conducted in the park. The Facebook and YouTube applications are used by different purposes; Facebook is potentially be used for different purposes, such as Twitter to follow a chosen topic or to update others. YouTube videos will be used in the future. Facebook is also used for information used for educational or promotional purposes.

The ‘best’ part of the geo-knowledge tool relates to the geographic element, shown in the data. The data has an easy to understand, is part based on the park planning and management, is based on the geographic location.
Appendix X – Final interface design of demonstration prototype prior to its review by users
Explanation of numbered items:

1. **Type relevant keywords** to refine results (demonstration prototype has predefined keywords only).
2. **Select a geographic area** such as a park, district, region, the whole of Parks Victoria, or type any geographic attribute. Alternatively, use the arrow tool in the map area below (see point 3) to draw and select a geographic area on the map (only Wilsons Promontory NP under Park button can be selected for demonstration prototype).
3. **Map area** updates as geographic attribute changes (demonstration prototype uses predefined maps only). Use blue arrow map tool to draw and select a geographic area (partly interactive during this exercise as indicated in step by step guide). Other map tools showing like zooming and panning are for display only.
4. **Select kind of data** to be included. One or more individual tabs (see step 6) at the top of each data type can be selected, or the ‘select all’ button will include all data (all tabs already selected in demonstration prototype).
5. **Select minimum ‘confidence rating’** level for alternative data by changing the slider to the appropriate setting. A confidence rating system is being designed as part of the research project to indicate the probable quality and usefulness of alternative data, ranging from 5 (highest) to 1 (lowest). For display only and data of varying confidence ratings are showing in the treemap - see point 7.
6. **Treemap area** displays available data that is updated as refined using any one of the options described in steps 1 – 5. Each box represents a data item. Green colours represent data related to Parks Victoria divided into Corporate, DSE, Local, Legislation and Stakeholders. The yellow-red shades represent alternative data sources divided into Organisations, References, Governments, Media and Social Media. Hovering over a tab gives a summary of expected data sources, and an explanation of the various shades under a data type tab. When interacting with a data box the relevant geographic area(s) will highlight in the map area (see point 3).
7. **Different shaded boxes** under a data type tab represent data with different confidence ratings (refer point 5.). The darker the shade, the higher the confidence rating.
8. **Small maps** represent geographic areas associated with data (geographic attributes), as well as geographic areas that have been zoomed to/selected. Small maps can be used to return to previous zoom levels (an active part of demonstration prototype using predefined zoom levels and maps as per point 2.).
9. **Site navigation tabs** to switch between the three locations of the site – Search, Work Area, and My Folder (to store data permanently). Search and Work Area tabs are partly interactive whereas My Folder is for display only.
10. **Information tabs.** The Help tab gives information how the tool works (an active tab); the Settings tabs has options like choosing a different treemap colour set and maximum number of data results visible for each data type (a non-active tab – colours and number of data items (set at 5) are not changeable).
11. **Location, date and weather information** current to the user’s location (for display only).
12. When the system or information was **last updated** (for display only).
13. **Standard items** on websites: contact details, privacy and copyright, and disclaimer (for display only).
Appendix XII – Overview of ‘Work Area’ component of the demonstration prototype
Explanation of numbered items:

1. **Data blocks selected** in the search area to keep or interact with. They are arranged by data type and confidence rating following the order of the treemap.

2. **Map area** of the tool, with user map tools and small maps used to represent relevant geographic areas (see Search overview - point 6). Demonstration prototype uses predefined maps.

3. **Personal user tools** and **data maintenance tools** for interacting with or manipulating selected data (for display only except when indicated in the step by step guide).

4. **Help tab** for information about how to use the work area (for display only).

5. Draggable handle to **increase/decrease the size of the map or work area** as required (generally a non-active part of the prototype except when indicated in the step by step guide).

6. Work area used to **interact with or manipulate the data selected** using the available tools.

7. **Left column’s two locations**: left, orange coloured tab shows the **selected data results**, whereas My Folder tab would show any **permanently saved data** (for display only and left column is fixed on the Selected Results tab).

8. Active link to go **back to the last zoom and refinement level** of Search area.

9. through to 13. are explained in the previous Search overview.
Appendix XIII – Feedback sheet for review of demonstration prototype

The primary objective of the research project is to explore how all of Park Victoria’s existing data might be made more accessible and supported by extensive ‘rich media’ data. The conceptual geo-knowledge tool being developed is a means to access Parks Victoria’s data as well as additional digital data and information available on the Web. It is to be assessed if these latter can benefit Park Victoria’s existing data.

*Can you please write down as many comments and thoughts you may have with regards to the following key questions? Although you have only worked with a demonstration prototype with limited capabilities and access to selected data, please try and consider these based on your understanding of an actual, fully operational geo-knowledge tool.*

1. Is the tool a means to make better use of Parks Victoria’s data? Consider:
   - All data in one tool
   - Use of keywords and geographic attributes to find relevant data
2. Is the combination of Parks Victoria data with alternative data in one tool potentially useful?
3. Could the additional information potentially complement or benefit Park Victoria’s existing data??

*Please write your thoughts in the box below and continue on the blank pages 3-4 if required.*
Please also provide any feedback or comments on the following questions. Again, please try and answer these bearing in mind a working geo-knowledge tool if possible.

A. Can you see a purpose for such a tool for some of your activities? If yes, can you give an example of a use scenario or activity?

B. What do you think of the overall design of the tool?

C. What do you think of the overall usability or ‘ease of use’ of the tool?
D. Do you have any suggestions for changes to the tool that would improve it or make it more usable in your opinion? You can use the box below or the attached sheet with copies of the two main screens to point out or mark specific items of the tool more easily.

Please use this page for any feedback or comments that don’t fit in the allocated boxes. [blank page followed]
Appendix XIV – Step-by-step guide for review of demonstration prototype

DEMONSTRATION PROTOTYPE – STEP BY STEP INSTRUCTIONS

There are 14 steps to go through. Each step has a brief summary, a screenshot, and one or more short tasks for you to complete. These tasks are indicated with arrow symbols (→).

With regards to the prototype, tabs or buttons with a red dot (*) indicate that parts are interactive (generally hover over, single click or drag). Interactive data blocks use a variety of symbols to show they can be hovered over (*), can be double clicked to open (••), can be selected with a single click (*), or are draggable (→).

Bearing in mind the use scenario, please complete this exercise as if you were involved in the preparations of an ecological burn that was to take place, and consider what data or information you may need, and in particular what data could be useful to find out the natural values in the area to be burnt. Try to consider this from a broad perspective, for example, could the alternative data potentially be useful for the purpose of providing additional information or insight, giving background details or being a means to refresh existing knowledge for example?

A separate feedback sheet is provided with additional questions for thoughts and comments that can be completed during or after completion of the exercise. There is also a separate handout that shows overviews of the two main locations you will be working in with explanations of the various components of the tool should you need this.

The background information handout explains the research project, development of the demonstration prototype and the limitations in more detail, and is also for your reference.

Please double click on the HomeDP.html file to open the demonstration prototype. Before you can start the exercise however, please follow the instructions in the attached ‘Flash Player Global Settings’ handout.

A note of warning: the above html file may not open due to security settings on your computer or if Internet Explorer is used. If this is the case, a message generally appears in a light yellow Information bar. Please click this Information bar, and then click ‘Allow Blocked Content’ and say ‘yes’ to the security warning that appears. The demonstration prototype should now be displayed and you can complete the Flash Player instructions.
Part 1 – Search location
This area is the data search and selection area, with a number of options to refine the data results that are displayed in the treemap (the coloured data blocks). The Search area is essentially one page that gets updated automatically as users use any of the four data refinement options available to them. The demonstration prototype requires you to follow a set of predefined steps. However, a working geo-knowledge tool would allow users to continuously refine data results using any number of the options available at any time and in any order.

Step 1. Opening page
The Search location shows the user tools, geographical map area at the top and the treemap area with data blocks at the bottom. Ideally, the user can make either map area smaller or bigger as desired using the draggable handle (see black arrow), however this feature is not an active part of the prototype. The opening page without any user refinements being applied shows broad or general data results in the treemap. The map is zoomed to Victoria, although the system could know where the user is located (for the prototype this is presumed to be Wilsons Prom and has zoomed one of the smaller maps to the park). Similarly, the broad data examples showing are partly related to Parks Victoria and partly to Wilsons Prom. Please note that clicking on the Search tab (indicated by the red arrow) at any point during this exercise will take you back to this opening page to start again.

Step 2. Interactive data blocks in the treemap
The coloured blocks in the treemap represent available and relevant data. A few blocks, indicated with a • symbol, can be hovered over to show a more detailed description. As you hover over the block, the relevant geographic areas are highlighted in the map area (either on the main map or one of the smaller maps). The block indicated with •• can be double clicked to open the data source in a new window (for any further investigation). The blocks that show ‘more results’ would be clickable in a real geo-knowledge tool to reveal additional relevant data results.
→ Use the options available to get a general feel of the prototype, the different types of data that have been used, and what is suggested the tool can do.
→ You can interact with any of the items indicated with red dots (*) such as the ‘Help’ and ‘?’ items, and data tabs (see black arrows).
→ In case you have moved to other parts of the tool through your exploration, click on the Search tab in preparation for the next step once you have finished with this step.

**Step 3. Selecting keywords to refine data results**
Data showing in the treemap can be refined using keywords. Typing in one or multiple keywords at any time would automatically update the data in the treemap and make it relevant to the keywords selected. The underlying idea is that all data, both Parks Victoria and alternative data sources, have been tagged with relevant keywords and geographic attributes. The data being displayed after selecting keywords is therefore any data tagged with those keywords. Users of the tool could also add their own keywords. Typing in keywords is not an interactive part of the demonstration prototype however, and you can only select a predefined set of keywords.

→ Hover over the ‘keyword’ box (indicated by red arrow) and click on the keywords that appear. (Note that for the purpose of the prototype, the data in the treemap will not yet be refined).
Step 4. Selecting geographic area
A geographic area of interest can be selected using one of the five boxes provided, or else by using the blue arrow map tool and selecting an area on the map. This action would again update the data results in the treemap and make them more appropriate to the geographic area selected. For the purpose of the prototype, Wilsons Promontory is the only park that can be selected using the ‘select by park’ option.

→ Select Wilsons Promontory National Park from the Park dropdown box.

Step 5. Map and data updated to reflect geographic area and keywords
The treemap data and map area have updated to better represent the selected keywords and geographic area. (To repeat the action, click on the small Victoria map to go back to the previous display and repeat step 4). Please note that for the purpose of the demonstration prototype only limited blocks have been updated.
Observe the change in data now displayed in the treemap and the changed geographic map as refined by the keywords and attributes. Two of the updated blocks indicated by the • symbol can be hovered over for more detail.

Step 6. Using blue arrow to draw an area to zoom to
The blue arrow tool (see blue arrow) can be used to zoom into any area on the map, but particularly areas that are not defined by clear geographic attributes like a park name. You will use the blue arrow tool to zoom closer to the area of focus, that is, the area to be burnt, with data blocks being updated accordingly. For the purpose of the prototype, the blue arrow tool is partly active but works differently than what it is intended. A square has already been ‘drawn’ that you can click on to zoom to the desired area.

Click on the blue arrow tool, and next click on the blue square (see black arrow) that has emerged.
(For the purpose of the demonstration prototype, only a few of the data blocks in the treemap will be updated – the map has zoomed in to the selected area). Hover over one of the interactive data blocks, indicated by the • symbol, for more information.
**Step 7. Using blue arrow tool to zoom in further**
To further define the area, repeat the previous step and use the blue arrow tool to zoom in closer to the burn area.

→ Click on the blue arrow tool, and next click on the blue square that emerges

**Step 8. Zoomed in area and updated data and map**
This is the final stage of the Search exercise. The full range of both traditional and alternative data that are potentially relevant for the ecological burn are shown in the treemap (remaining blocks have been filled with examples of other data or remained as they were). The blocks indicated with the * symbol are interactive and can be hovered over to show more detail whilst their geographic attributes are simultaneously highlighted in the map area. Additionally, these interactive blocks can be selected to keep and interact with in the Work Area location. A working geo-knowledge tool would let users select a data block at any time to keep for later. This block would stay selected and ‘saved’ even if the data blocks were updated afterwards using new keywords or geographic areas.

→ Please hover over some of the data blocks to observe what potentially relevant data exist.
→ To select a block, click on it once (the block will show a red outline). To deselect the block, click again (the red outline will disappear)
→ You can also use the small maps (see black arrows) to zoom back and forward between previous zoom levels.
**Step 9. Select data to save for further interaction in the Work Area**

> Once your interaction at this page is finished, select a few of the data blocks you wish to keep by clicking on them once and click on the Work Area tab at the top (see red arrow).

**Part 2 – Work Area location**

The proposed Work Area of the geo-knowledge tool is the location where users can interact with data they have selected. Selected data would remain in the Work Area until users delete it, save it permanently in an area called ‘My Folder’, or exit the tool. Users can therefore switch between Search and Work Area to search for new data to add to their already selected results. (Please do not click on the Search tab at this point as it will take you back to step 1.) The screen of Work Area comprises a map area (top section) and a work area (bottom section) with a variety of tools.
**Step 10. Showing selected results in Work Area**
The previous selected results are shown in a column on the left under the ‘Selected Results’ tab (see red arrow). For the purpose of the demonstration prototype, all selectable data in the previous step are shown on the left.

→ Hover over any of the selected results to see more detailed information

![Image showing selected results](image1.png)

**Step 11. Dragging handle to make map and work area smaller/bigger as desired**
The size of the map area and work area can be changed as required by the user using the draggable handle of the line that separates them (see red arrow). For the purpose of the prototype, this action is demonstrated at this point.

→ Drag the handle up and down to see how either area can be reduced or enlarged.

![Image showing handle](image2.png)
Step 12. Personal user tools and data maintenance tools
There are a number of tools available to interact with the selected data, which are accessible via two tabs in the top left of the work area (see red arrows). Suggested user tools include the ability to annotate, zoom and search as well as a notepad and the ability to save data, comments, notes, annotations etc. permanently in My Folder (this is the second tab in the left column (see black arrow) and is a non-active part of the prototype).
Suggested data maintenance tools would allow users to add keywords, comments and confidence rating to the data for others to consider (as part of the ongoing maintenance of the confidence rating system). Note that none of these tools are an interactive part of the prototype, and are for display only to show the possibilities of the geo-knowledge tool.

→ Due to technical limitations of the prototype, please click on the map area once to activate the next interactive part (in a real geo-knowledge tool, all interactive parts would work simultaneously).
→ Hover over the two tool tabs to see what data manipulation tools are proposed.

Step 13. Dragging search results into work area for manipulation
The selected results can be dragged onto the work area, at which point they can be opened and interacted with. Multiple data items can be placed onto the work area as required. To replicate this idea, a few data items identified by the ➤ symbol are draggable.
Drag some of the draggable data items onto the work area.

**Step 14. Opening data items in the work area**
Once items are in the work area, they can be opened for interaction.

- Again, due to technical limitations of the prototype, please click on the map area once to activate the next interactive part. A predefined selection of data items is now shown in the work area.
- Click once on any of the items in the work area to open them up in a different window. You can open multiple ones at the time. Note that for the purpose of being able to compare and assess what data are potentially available, all data items including the ones in the left column can be opened at this stage.
Step 15. Opening a manipulated document with proposed tools attached

Finally, to demonstrate how the user tools may work, two of the data items have been replicated to show personal user and data maintenance tools attached (see red arrow). Note however that these are for display purposes only and the tools are not interactive.

→ Please click on the map area once to activate the next interactive part.
→ You can open up one of the two manipulated documents in the work area, indicated by the •• symbol, to see one how users may potentially interact with or manipulate the data. (Note that all other data items including the ones in the left column can also still be opened at this stage, but they will not show these tools).

This is the end of the review. Feel free to have another look around the tool – you can use the Search tab to get back to the beginning, the Work Area tab to start at the beginning of the work area part, or the ‘Back to last search results’ link in the left bottom to get back to the last zoomed in area and results. You can then use the small maps to go back to previous zoom levels or use any of the previous steps.

Thank you for your participation and feedback!