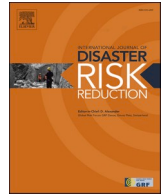




Contents lists available at ScienceDirect

## International Journal of Disaster Risk Reduction

journal homepage: <http://www.elsevier.com/locate/ijdr>

# Integrating wildfire risk management and spatial planning – A historical review of two Australian planning systems

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## ARTICLE INFO

## Keywords:

Integration  
Wildfire  
Spatial planning  
Urban planning  
Disaster risk management  
Governance

## ABSTRACT

Recent wildfires burning throughout Australia highlight the vulnerability of settlements located in wildland urban interface (WUI) areas. Spatial planning has a critical role in operationalising wildfire risk reduction considerations in a territorial manner across the WUI. Accordingly, more integrated approaches to wildfire management and spatial planning are necessary. However, there is limited literature examining the historical interactions between wildfire and spatial planning policy sectors and how institutions and policy instruments adapt over time to integrate mutually dependent considerations. To address this gap, this research examines how Australian spatial planning institutions and instruments evolved since European settlement to incorporate wildfire considerations, through a qualitative comparative case study approach of two Australian states. Based on the findings of the case study comparison, this paper presents a conceptual framework of the pathways towards increased policy integration of spatial planning and wildfire risk reduction that consists of six phases. It is argued that the path to greater policy integration is grounded on the development of common knowledge, a cross-disciplinary understanding, and agreed policy goals between different policy sectors, that, with time, translate into new institutional arrangements and instruments that integrate the work and decision-making processes of different sectors.

## 1. Introduction

Wildfires (referred to as bushfires in Australia) are inherent to the Australian landscape. Australia's fire regime is dominated by frequent low-intensity fires, with less frequent but extremely intense fires in the southern continent where the majority of the population reside [1,2]. The potential for high intensity fires to become catastrophic disaster events was demonstrated by the Black Summer fires of 2019–2020 which burnt over ten thousand hectares, resulting in 33 deaths and the loss of more than 3000 properties [3]. Contributing to this trend, climate change is generating higher, more prolonged fire danger conditions and increasing the frequency of extreme wildfire events in Australia's southern regions [4–6].

Australian settlement patterns have created a morphology of low-density urban sprawl, and rural-residential developments that encroach into fire-prone wildland areas and increase wildfire risks.

Many Australian wildland urban interface (WUI) settlements contain significant fire fuel; most structures were built before the inclusion of wildfire risk consideration in planning and building regulations [7]; there has been extensive land fragmentation [8]; and road layouts are often constrained. These settlement patterns have altered fire regimes across southern Australia, contributing to more catastrophic wildfire events [9,10]. Furthermore, significant urban growth in southern Australia is correlated to higher rates of human-caused ignition [11]. WUI areas imply greater disaster risk because here more lives and properties are exposed to wildfires. Therefore, it is imperative to address wildfire risk reduction through the management and planning of settlements.

Approaches to wildfire management in Australia have evolved remarkably over time, as a result of technical and scientific developments, shifting policy priorities and changing worldview perspectives [12], and it is now acknowledged that more all-encompassing

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<https://doi.org/10.1016/j.ijdr.2020.101984>

Received 16 January 2020; Received in revised form 20 November 2020; Accepted 20 November 2020

Available online 1 December 2020

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approaches are imperative. Aboriginal people, through their mosaic burning practices to maintain landscapes and facilitate resource supply, managed fire in the region for some 40,000–60,000 years [13,14]. With European settlement, a very different approach to wildfire management was established [15], which focused primarily on incident response [16]. Incident response long persisted as the dominant approach to minimising wildfire impacts. However, the sector has increasingly shifted towards preventative and risk-based wildfire management [17]. More recently, the adoption of a resilience-based policy approach has widened the scope of wildfire management to consider broader factors relating to vulnerability and adaptation [18]. Hence, Australian wildfire risk reduction is no longer viewed as the sole responsibility of the emergency management sector, but as a shared responsibility of a range of actors [19].

Spatial planning can contribute to operationalising wildfire risk reduction considerations in a territorial manner across the WUI. Spatial planning refers to the broad processes and mechanisms for dealing with the spatial distribution of activities and coordinating spatial policies to achieve improved settlements [20]. Research has established that settlements' characteristics, location, and physical design, affect both the likelihood and consequence of wildfires [21,22]. Disaster policy in Australia, and abroad, has therefore recognised spatial planning as a critical player for reducing wildfire risk in WUI areas [18,23]. However, while emergency managers are urged to consider spatial planning as a risk reduction measure, they often lack appropriate spatial planning knowledge and land-use decision-making authority.

Traditionally, spatial planning in Australia focused on the physical characteristics of settlements and the distribution of land-uses through the production of end-state plans. Over time, the sector's focus has broadened, moving to a more holistic discipline [24]. Spatial planning occurs through instruments such as legislation, regulations, agendas, policies, visions, designs and strategies at various spatial scales, from national to local [25]. Spatial planning can play an important role in operationalising disaster resilience by including wildfire risk considerations when directing settlement growth, use and design [21,26]. However, while spatial planners are urged to address wildfire risk reduction, they have a subsidiary role in this [27]. Furthermore, they are constrained by legacy issues from earlier spatial planning decisions, development pressure and a reliance on traditional planning instruments that focus on new development rather than existing settlements [20].

There is consensus that an integrated policy approach between wildfire management and spatial planning is critical for disaster risk reduction (DRR) [1,22]. Policy integration requires coordinated efforts between at least two sectors to more effectively address a mutually interdependent policy issue [28]. Understood as an ongoing process of institutional change rather than a policy outcome in itself [29], policy integration entails the design and recalibration of policy instruments to achieve more consistent and coherent policy goals [30].

There is emergent research about conditions that facilitate linkages between interdependent actors [31], and enable effective policy integration between sectors [29]. From a DRR perspective, key dimensions of policy integration identified in the literature include: (a) recognition of the need for an integrated approach and cross-disciplinary understanding; (b) strengthening of a coordinated governance structure and cross-sector collaboration of spatial planning and DRR institutions, interacting vertically, horizontally and functionally; (c) establishment of mixed policy instruments that cut across the sectors; (d) improvement of knowledge and information through comprehensive and systematic risk assessments for integrated decision-making; (e) encouragement of institutional learning from implemented policies and experiences; and (f) consideration of the multiple scales of space and time in which actions can be taken [22,29,32].

Over the past decade, spatial planning systems across Australia have undergone policy reforms to strengthen the integration of spatial planning and wildfire management [20]. However, to date, few studies have

examined the historical interactions between wildfire management and spatial planning. To address this gap, this paper examines how the sectors of spatial planning and wildfire management in two Australian states have evolved and interacted since European settlement towards a more integrated approach to wildfire risk reduction. Turning to the past can contribute insight into the different drivers and impediments of policy integration between sectors, enabling us to better understand complex policy problems and assess the feasibility of possible solutions [33]. This paper builds upon emerging policy integration literature [22, 29,32]. Using the findings of the case study comparison, a conceptual framework of the key phases towards increased policy integration of spatial planning and wildfire risk reduction is presented. While this framework is specific to spatial planning in wildfire-prone areas, it has the potential to be used as an analytic tool for broader DRR and policy integration research.

## 2. Method – two Australian case studies

This qualitative study was approached using a comparative case study strategy [34]. The spatial planning system and wildfire management systems of the Australian states of Victoria and Western Australia (WA) were selected as case study subjects. Given WA's size and environmental variation, the study focussed on the South-West of Western Australia (see Fig. 1), where the majority of the state's population reside. The criteria for selecting these two cases include: both territories are prone to severe wildfires; the growth of peri-urban settlements within the cases is increasing wildfire risk, and both spatial planning systems have addressed the wildfire challenge through ongoing policy reform.

### 2.1. Case study 1: Victoria

The state of Victoria, located in the south-east of Australia's mainland (Fig. 1), has large fire-prone areas, and a wildfire regime dominated by occasional very high-intensity fires [2,35]. Historically, several devastating events impacted populated areas: Red Tuesday (1898), Black Friday (1939), Ash Wednesday (1983), Black Saturday (2009), and Black Summer (2019-2020). Settlement patterns have affected wildfires' frequency and severity [9]. Currently, Victorian WUI areas are among the most vulnerable to wildfires worldwide [8].

Victoria's spatial planning system is framed at the state level and administered at the local level. At the state level, the Planning and Environment Act [36] is the legislative framework and the Victoria Planning Provisions (VPP) are subsidiary legislation providing a template of standardised state-wide planning schemes. At the local level, planning schemes establish strategies, policies and provisions for land's use, development and protection, through ordinances, maps, and incorporated documents based on the VPP template. Victorian planning agencies are characterised by a three-way relationship: (1) state; (2) local; and (3) a series of sectoral or project-oriented agencies [37]. The Department of Environment, Land, Water and Planning (DELWP) is the key statutory authority for planning and development for the state. Local governments usually prepare planning schemes and decide on development applications on land included in the corresponding local planning scheme. The Country Fire Authority (CFA) is Victoria's primary wildfire emergency management agency outside inner Melbourne.

### 2.2. Case study 2: South-west of Western Australia

The south-west of Western Australia (south-west WA)<sup>1</sup> (Fig. 1), home to around 80% of the state's population, is vulnerable to large wildfire

<sup>1</sup> The south-west of WA defined herein refers to a geographical area of Western Australia that closely corresponds with the boundaries of South West Land Division, the South West Agricultural Region and the South West Australian Ecoregion.



Fig. 1. Map of Australia and the States of WA and Victoria (Source: adapted from Ref. [49]).

events [38,39]. Since the 1960s, the fire regimes of south-west WA have been dominated by prescribed burns of low to moderate intensity with decadal frequency, with occasional high-intensity wildfires [40]. WA has not historically experienced the same extent of wildfire devastation as Victoria, however, past wildfire events such as the Dwellingup fires (1961) and the more recent Waroona Fires (2016) demonstrate the propensity of extreme wildfires in the area with potentially catastrophic impacts.

Spatial planning in WA is framed at the state level with some administration delegated to the municipal level. At the state level, the Planning and Development Act [41] is the legislative framework and the State Planning Policies (SPPs) support an integrative decision-making framework between the various levels of planning [42]. At the local level, planning schemes establish the way land is to be used and developed, supported by strategies, policies and provisions (mandatory or indicative), including ordinances, maps, and incorporated documents. WA planning agencies are also characterised by a three-way relationship: (1) state; (2) local; and (3) sectoral or project-oriented agencies. The Western Australian Planning Commission (WAPC) is the statutory authority for planning and development for the whole state. Local governments usually prepare planning schemes and decide on development applications on land included in the corresponding local planning scheme. The Department of Fire and Emergency Services (DFES) is WA's primary wildfire emergency management agency.

### 2.3. Data collection and analysis

This study explores the changing foci of spatial planning and wildfire management over time and examines the evolving interactions between these two sectors towards a more integrated policy approach. The research employed a qualitative content analysis (QCA) approach [43], to examine textual data in the form of archival and contemporary policy documentation relating to spatial planning and wildfire management.

QCA is a flexible methodology that aims to identify patterns and parallels that characterise a particular phenomenon [44]. This study uses the method of process tracing, a QCA technique concerned with examining the sequencing of particular events and identifying causal mechanisms [45], which link particular antecedent conditions to specific outcomes [46]. Process tracing involves the longitudinal analysis of chronological events and is concerned with what happens over a period of time and why [47]. Accordingly, each case was analysed to elicit causal factors driving policy integration and to identify different phases that characterised the process of policy integration. Furthermore, comparative case studies are appropriate for process tracing because when similar underpinning conditions and patterns in the sequencing of events are observed repeatedly in different contexts, likely causal mechanisms can be revealed [45]. Periodization, whereby temporal phases are distinguished to allow for the comparison of similarities and differences between cases, is an important part of process tracing [48]. Thus, the cases were compared to identify common trends, influencers and barriers of integration.

This study takes the starting point of 1850; a period identified with the incipient self-government of the Australian colonies. Using keywords relating to spatial planning and wildfire management, a thorough desktop search of Victorian and Western Australian public library catalogues, legislation archives, and government department websites was undertaken and an inventory of texts that included strategies, guidelines, records, legal documents, special inquiries, research and historical texts from each of these states was compiled. An initial screening of these texts was undertaken to identify key policy documentation that was considered 1) integral to the formation of each sectors' institutional configurations 2) represented significant sectorial changes or increased integration between the two sectors; and 3) was linked to a particular condition or event (a causal trigger or driver) that initiated the change and strengthened policy integration. A total of 54 documents were analysed for this study (Victoria n: 26; WA n: 23; National n: 5)

presented in Tables 1–6

### 3. Results – policy pathways towards greater integration

Based on the analysis of the different phases that characterised the process of policy integration per case study, and a cross-case synthesis of them, a conceptual framework of key trajectory phases for the policy integration of wildfire management and spatial planning was developed (presented in Fig. 2). This framework provides a characterisation of the different historical periods and institutional interactions and gives a snapshot of critical events and actions associated with the policy integration of spatial planning and wildfire risk management. The limitations associated with process framing and this analysis’ temporal periodization of integration are acknowledged, including that policy developments are often non-linear and are influenced by a combination of factors. Nevertheless, this framework provides a valuable analysis tool for examining processes of policy integration for DRR. Furthermore, Tables 1–6 list the key policy instruments, characteristics, and changes as well as the key drivers and triggers towards integration per case for each of the six phases.

#### 3.1. Independent beginnings of spatial planning and wildfire management

The early stages of European settlers’ wildfire management across Australia focussed predominately on wildfire response. A formal wildfire management sector in both Victoria and WA originated through the enactment of fire brigade legislation during the late 19th century (see no. 1 and 8, Table 1). This entailed the establishment of fire brigade boards that were granted the governing authority for wildfire response. The overarching objective of these early institutions was to protect life and property from fire incidents, and this priority persisted throughout the 20th century as the key focus of wildfire management systems in both cases.

In the early 20th Century, the origins of archetypal planning can be identified in both cases. Like many Australian policy sectors, the roles of local and state government in spatial planning were determined during this post-Federation era. The requirement for local governments to

prescribe residential zones, prohibiting or regulating certain activities or developments, can be traced to seminal legislation passed during the 1920s in both cases (see no. 4 and 12, Table 1). Procedures for preparing, amending, and revoking planning schemes, and planning approval processes were further formalised in Victoria during the 1940s with the enactment of town planning legislation (see. no. 6, Table 1), and during the late 1960s in WA with subsidiary town planning legislation (see no. 13, Table 1). Many of the institutional processes that were established during the early to mid-twentieth century by these legislative instruments, despite important adjustments, have been retained in both Victoria’s and WA’s current statutory planning systems.

Despite the lack of integration between the two systems during this period, there is evidence of a nascent awareness regarding the interrelationship between wildfire risk and building and site location and design during this period (see no.7, Table 1). This suggests an emergent recognition of the mutual interdependency of spatial planning and wildfire management systems and the need for a coordinated approach. For example, a Victorian Royal Commission into the Black Friday events (1939) recommended better cooperation between agencies, for sawmills to be directed away from fire danger areas, and the need for turning points on narrow roads for fire brigade vehicles [50]. Similarly, the Royal Commission for the 1960/1961 Dwellingup wildfires in south-west WA emphasised the importance of firebreaks between forests and private properties and recommended sufficient separation between properties to reduce fire spreading and to support firefighting operations [51].

#### 3.2. Developing common knowledge and a cross-disciplinary understanding

In Victoria, guidance for the design and siting of rural subdivision emerged during the late 1970s, early 1980s (see no. 1 and 2, Table 2). The critical role that land-use planning could play in wildfire risk reduction, by designating fire-prone areas, was reinforced by research and inquiries following the Ash Wednesday wildfire that impacted Victoria in 1983 [67]. Following this, Australia’s first National Inquiry into wildfires highlighted the inadequate attention given by the states to

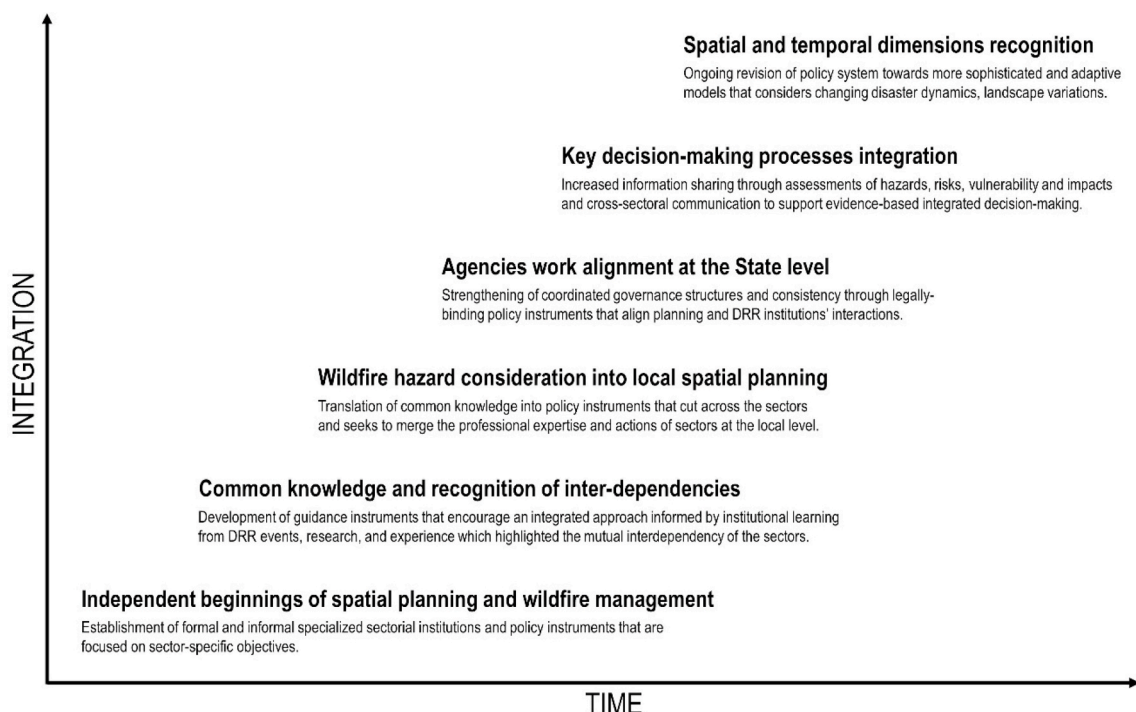


Fig. 2. Spatial planning systems’ trajectory to gradually adapt to integrated wildfire risk management.

**Table 1**

Summary of key characteristics and changes, and key influences and triggers during the independent beginnings of spatial planning and wildfire management.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	Wildfire risk management: 1. Fire Brigades Act [52] 2. Country Fire Authority Act [53]  3. Forest Act [54]; the Metropolitan Fire Brigades Act [55]; and the Country Fire Authority Act [56] Spatial planning: 4. Local Government Act [57] 5. Slum Reclamation and Housing Act [58]. 6. Town and Country Planning Act [59]	<ul style="list-style-type: none"> <li>&gt; Established first formal fire management institutions.</li> <li>&gt; Established state-wide authority for fire management outside metropolitan area.</li> <li>&gt; Consolidated fire management legislative framework.</li> <li>&gt; Authorised local government to prescribe residential zones and regulate land use.</li> <li>&gt; Enabled local government to develop plans, maps, schemes, and zoning for future development.</li> <li>&gt; Introduced schematic and statutory planning, established processes for planning scheme preparation and the planning permit decisions.</li> </ul>	International trends associated with progressing a modern economy. Federation (1901) Black Friday (1939). Victoria Royal Commission & Stretton Report [50]
South-West WA	7. A Survey of Houses Affected in the Beaumaris Fire, January 14, 1944 by Barrow [60] Wildfire risk management: 8. Fire Brigades Act [61] 9. District Fire Brigade Act [62] 10. Forest Act [63]  11. Bushfire Act [64] Spatial planning: 12. Town Planning and Development Act [65]. 13. Town Planning Regulations [66]	<ul style="list-style-type: none"> <li>&gt; Verified the correlation between house survival to a wildfire and its construction, design and siting characteristics for the first time.</li> <li>&gt; Established first formal fire management institutions.</li> <li>&gt; Established state-wide authority for fire response</li> <li>&gt; Established Forest Department responsible for fire control in state forest</li> <li>&gt; Granted local governments more fire management powers.</li> <li>&gt; Positioned state Town Planning Board as central planning authority and made provision for local Town Planning Schemes.</li> <li>&gt; Established procedures for the preparation of local schemes and planning permit decisions.</li> </ul>	International trends associated with progressing modern economies. Federation (1901) Population growth during gold rush. Great Coolgardie Fires (1885). Series of damaging wildfires in south-west WA (1923–1924). Dwellingup wildfires (1960/1961). Royal Commission [51].

**Table 2**

Summary of key characteristics and changes, and key influences and triggers during the development of common knowledge and disciplinary understanding.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. “Design and Siting Guidelines: Rural Subdivision Principles” [70]. 2. “Design and siting guidelines: bush fire protection for rural houses” [71] 3. “Planning conditions and guidelines for subdivisions” [72].	<ul style="list-style-type: none"> <li>&gt; Provided guidance for the design and siting of rural subdivision in wildfire-prone areas.</li> <li>&gt; Provided guidance for the design and siting of rural houses in wildfire-prone areas.</li> <li>&gt; Provided guidance for the preparation and assessment of subdivision plans in wildfire contexts that could be incorporated in local planning schemes.</li> </ul>	International and national trend towards disaster prevention. Ash Wednesday (1983). Inquiries on Ash Wednesday (1984). National standards for construction of buildings in bushfire-prone areas [69].
South-West WA	4. SAA HB36 - Building in bushfire-prone areas: information and advice [73]. 5. The Homeowner’s Bushfire Survival Manual [74]. 6. “Planning for Better Bushfire Protection Guidelines” [75]. 7. 1991 - Policy for Development Control (4.2), Planning for Hazards and Safety [76]	<ul style="list-style-type: none"> <li>&gt; Provided advice about the design, construction, siting, landscaping, and maintenance of buildings in wildfire-prone areas</li> <li>&gt; Provided guidance for wildfire sensitive building design, site selection and protection measures.</li> <li>&gt; Provided guidance for the design and siting of rural subdivision in wildfire-prone areas.</li> <li>&gt; Provided guidance for planning decision-making in wildfire-prone areas.</li> </ul>	International and national trends towards disaster prevention. The knowledge emanating from Victoria and NSW about wildfire planning Recommendations from the first national inquiry into wildfires to advance wildfire consideration in planning. House of Representatives Standing Committee on Environment and Conservation [68] National standards for construction of buildings in bushfire-prone areas [69].

wildfire risk in land-use planning frameworks across Australia and recommended urgent action to address this [68]. Interestingly, there was no evidence of guidance for the design and siting of subdivisions specifically published for WA in the late 70s and early 80s as was the case in Victoria.

During the late 1980s and early 1990s, the operationalisation of wildfire risk management into planning instruments started to be considered and a set of guides and standards were developed in Victoria (See no. 3 and 4, Table 2) and WA (see no. 5 and 6, Table 2). At a national level, the first construction standards for building in wildfire-prone areas were published in 1991 to improve the performance of buildings to ember attack [69]. In the case of WA, wildfire considerations in spatial planning were further advanced through a

state-level development control policy (see no. 7, Table 2), which required local planning decisions to consider wildfire probability and avoid development in areas where fire protection could not be achieved.

### 3.3. Including wildfire considerations and knowledge into local plans

Informed by the growing awareness of spatial planning’s potential role in wildfire DRR, wildfire considerations for spatial planning began to be translated into local planning instruments during the late 1980s and early 1990s. In Victoria, based on research and recommendations following Ash Wednesday, the first indication of a local planning scheme (see No 1, Table 3) incorporating wildfire regulations such as water provision, site separation, access and egress, and building and site

**Table 3**

Summary of the key characteristics and changes, key influences and triggers during the stage of including wildfire considerations and knowledge into the planning system.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1.1985 – Shire of Upper Yarra Planning Scheme [76,77]. 2.1987 – Planning and Environment Act [36]. 3.1992 – Amendment no. 29 to the Yarra Ranges regional strategy plan [78].	> Applied wildfire protection measures at the local level. > Introduced the submission of planning permit application to referral authorities. > Indicated that fire prevention and suppression must be coordinated across agencies and that Planning Authorities must consider wildfires in local planning schemes.	Growing awareness of spatial planning's potential role in wildfire DRR. Ash Wednesday (1983). Research following Ash Wednesday. First National Inquiry into Bushfire recommending land-use planning to apply greater wildfire protection measures.
South-West WA	4.1992 – Augusta-Margaret River Rural strategy [79]. 5.1998: the Leeuwin-Naturaliste Ridge State Planning policy (PS 1.12) [80]	> Applied wildfire protection measures at the local level. > Advised that wildfire protection strategies be incorporated in all rural residential planning proposals.	Growing awareness of spatial planning's potential role in wildfire DRR. Research following Ash Wednesday.

design emerged in 1985. In WA wildfire hazard assessments and fire protection planning requirements were incorporated into a 1992 rural planning strategy for a particularly wildfire-prone shire district located in south-west WA. (see no. 4, Table 3). Furthermore, by 1998 (see no. 5, Table 3) a state policy was enacted in WA requiring wildfire protection strategies be incorporated in all rural residential and clustered settlement proposals in a wildfire-prone sub-region of south-west WA. In the case of Victoria, the regional strategic planning level (no. 3, Table 3), started to include some consideration about wildfires indicating that development within identified buffer zones be prohibited when considering permit applications in wildfire-prone areas.

### 3.4. Formalising the state-level institutional arrangements to align the work of the agencies

In both cases, the spatial planning systems progressed to establish state-level institutional arrangements – regulatory for Victoria and indicative for WA – that framed lower tiers of planning and aligned their work with wildfire risk reduction. In Victoria, the Wildfire Management Overlay (WMO) – the first state-wide wildfire specific statutory planning tool – was established within the overall restructuring of the planning system in 1997 and the introduction of the Victoria Planning Provisions (VPP) (see no.1, Table 4). Each council was responsible for adopting the WMO into its planning scheme through mapping wildfire-prone areas. It established extra-statutory requirements for development to include wildfire protection measures. Furthermore, it stipulated that the responsible decision-making authority must determine whether a planning permit proposal satisfied requirements, or needed further assessment by the relevant wildfire authority, predominately the Country Fire Authority (CFA). In WA, changes were also emerging at the state level to formally align spatial planning and wildfire management through the development of cross-sectoral policy guidance and strategic non-binding

instruments. Wildfire risk considerations were reinforced as a key responsibility of spatial planning in 1999 (see no. 2, Table 4), with guidance stipulating that in approving planning applications local governments should consider wildfire risk and include Special Control Areas (SCA) to deal with specific issues such as wildfire protection. Moreover, in 2001, wildfire protection planning guidelines (see no. 3, Table 4) were revised with the intent to 'formalise the integration of fire protection into the planning process' [81] p. iii. These guidelines provided procedural recommendations for local government to identify wildfire-prone areas and set out performance criteria for subdivision and development depending on the wildfire risk. Following the restructure of WA's planning system in 2005, which included the provision for State Planning Policies (SPPs), a State Planning Policy for Natural Hazards and Disasters (see no. 4, Table 4) was released. This development reinforced the role of local governments in identifying and restricting development in wildfire-prone areas.

Limitations associated with the operationalisation of these first state-level institutional arrangements to align the work of spatial planning and DRR are evident. Victoria's WMO mitigation measures were regularly reduced to facilitate other objectives such as vegetation retention. Furthermore, the WMO mapping was applied only to areas where high-intensity wildfires were expected to be difficult to control. This meant that by 2009 the WMO was only applied in 35 of Victoria's 82 planning schemes using inconsistent mapping criteria between local governments [82]. Furthermore, the policy setting for planning in wildfire-prone areas in WA during this time imposed no legal obligations on local governments to declare wildfire-prone areas. While local governments were encouraged to declare wildfire-prone areas, by 2011 only 2 out of 139 local governments in WA had done so and were, hence, required to comply with the performance criteria presented in the guidelines and the wildfire construction standards [83].

**Table 4**

Summary of key characteristics and changes, key influences and triggers during the formalization of the state-level institutional arrangements to align the work of the agencies.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1.1997 – Wildfire Management Overlay (WMO).	> Introduced first state-wide wildfire specific planning tool.	Planning re-structuring and introduction of Victoria Planning Provisions (VPP) International trend of adopting a preventative, risk-based approach in DRR
South-West WA	2.1999 – Town Planning Regulations amendment [84]. 3.2001 – "Planning for Bush Fire Protection Guidelines" [81]. 4.2006 – SPP 3.4 for Natural Hazards and Disasters.	> Stipulated that local government schemes consider wildfire and designate Special Control Areas (SCA) for wildfire-prone areas. > Attempted to formalise the integration of wildfire protection into WA spatial planning system. > Advised that all planning instruments and decisions must give due regard to wildfire risk.	Planning re-structuring and introduction of Planning and Development Act [41]. The International trend of adopting a preventative, risk-based approach in DRR

**Table 5**

Summary of key characteristics and changes, key influences and triggers during the integration of key the decision-making process within and between agencies.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. 2011 – VPP Amendment VC83 (November 18, 2011).  2. 2011 – Regulation 810 of the Building Regulations 2006, [86,87]. 3. 2014 - VPP Amendment VC109 (July 31, 2014). 4. 2017 – VPP Amendment GC13 (October 3, 2017)	<ul style="list-style-type: none"> <li>&gt; Replaced the WMO with the Bushfire Management Overlay (BMO), establishing mandatory conditions, exemptions, and general decisions guidelines for BMO areas.</li> <li>&gt; Established CFA as a determining referral authority for BMO areas.</li> <li>&gt; Transferred responsibility for BPA and BMO mapping to DELWP.</li> <li>&gt; Recommended the CFA as a referral authority for BMO areas.</li> <li>&gt; Updated BMO mapping based on criteria updated in 2013.</li> </ul>	Black Saturday wildfires (2009). Victoria Royal Commission [82] key planning and building controls recommendations. The limitations associated with operationalisation of these first state-level institutional arrangements.
South-West Western Australia	5. 2010 – ‘Planning for Bush Fire Protection Guidelines’ (2nd Edition) [88]. 6. 2015 – State Planning Policy (SPP) 3.7 Planning in Bushfire Prone Areas [85] 7. Planning in Bushfire Prone Areas Guidelines [89] 8.2015 – State Bushfire Prone Area Map. [90]. 9.2015 – Amendment to the Planning and Development (Local Planning Schemes) Regulations [91].	<ul style="list-style-type: none"> <li>&gt; Introduced referral of high-risk planning applications to State Fire and Emergency Services Authority.</li> <li>&gt; Provided highest-level policy guidance to integrate wildfire risk into spatial planning.</li> <li>&gt; Introduced state endorsed standards for assessing planning proposals within wildfire-prone areas.</li> <li>&gt; Transferred responsibility for designating wildfire-prone areas from local governments to the state.</li> <li>&gt; Established a legally binding framework for the integration of wildfire risk and spatial planning.</li> </ul>	Black Saturday wildfires (2009). Perth Hills Wildfire (2011). Special inquiry report for the Perth Hills Bushfire recommendations to give planning in wildfire-prone areas legislative effect [83].

**3.5. Integrating key decision-making processes within and between agencies**

The recommendations emanating from the Victorian Royal Commission into the Black Saturday wildfire (2009), the worst recorded wildfire in Australia’s history had a far-reaching impact. In Victoria, in 2011 the requirements for wildfire areas were adjusted and the responsibilities across the planning and wildfire agencies in key decision-making processes were revised (see no. 1, Table 5). Notably, the WMO was replaced by the Bushfire Management Overlay (BMO), and the role of the CFA, as the key wildfire management agency, in planning permit decision-making and wildfire-prone mapping was strengthened. Since the 2011 reforms, spatial planning’s wildfire considerations have been adjusted, corrected and relaxed, yet have maintained the general intentions. Another critical change is that responsibilities for mapping were re-allocated and the mapping criteria were changed several times. Instead of local governments, a single state agency –The Department of Environment, Land, Water and Planning (DELWP) – is now responsible for mapping the BMO to ensure consistent criteria are applied across the State.

Comparatively, based on the recommendations of the inquiry into Perth Hills (2011) wildfire [83], greater changes were introduced to increase decision-making integration for wildfire risk reduction. A new policy reform package was released in 2015, which included a specific State Planning Policy for planning in wildfire-prone areas (see no. 6,

Table 5). This new policy provided guidance to address wildfire risk at all levels of planning [85]. Wildfire prone areas started to be identified at the state level by the Fire and Emergency Services (FES) Commissioner through the State Bushfire Prone Area Map and revised guidelines were given legislative effect (see no. 7, 8 and 9, Table 5). Furthermore, the advice from the state’s wildfire management agency, the Department of Fire and Emergency Services (DFES), as a referral agency must now be sought when the proposal involves an unavoidable, vulnerable or high-risk land use in a wildfire-prone area.

**3.6. Recognising the systems’ different dynamic spatial and temporal scales**

The need to consider different spatial dimensions has informed recent developments in both cases. These recent developments seek to consider the landscape scale of wildfires and context-specific characteristics in the strategic planning process as well as the planning permit and development approval processes. In Victoria, this trend is illustrated by minor adjustments at the strategic level accompanied by extensive training (see no. 1 and 2, Table 6) to promote greater consideration of the landscape scale. These are intended to strengthen the system’s capacity to direct new development to low-risk areas and reinforce the legal grounds to refuse a planning permit when the landscape context is considered too risky. In WA, a recent review of the policy framework (see no. 3, Table 6) highlighted the limitations of the current wildfire-

**Table 6**

Summary of key characteristics and changes, key influences and triggers during the recognition of the systems’ different spatial and temporal dimensions.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. 2017 – VPP Amendment VC140 (December 12, 2017).  2. 2018–2019 – Education program for planners provided by DELWP.	<ul style="list-style-type: none"> <li>&gt; Adjusted the VPP at the strategic level to prioritise human life, direct development to low risk locations, and strengthen wildfire consideration at the landscape scale.</li> <li>&gt; Improved planners’ wildfire knowledge.</li> <li>&gt; Emphasised consideration of the landscape level to direct development to low wildfire risk areas.</li> </ul>	Recognition of current system limitations to direct development to low-risk areas and of the capacity of planners to deal with wildfires matters.
South-West WA	3. 2019 – “Bushfire Planning and Policy Review: A Review into the Western Australian Framework for Planning and Development in Bushfire Prone Areas” [93].	> Identified key issues of the current system and recommended a more moderate mapping standard that considers specific landscape issues and wildfire risk levels.	Criticisms of the WA wildfire planning framework being too risk-averse and failing to consider wildfire at the landscape scale.

prone mapping system and recommended a new methodological approach that recognises the different scales of development and landscape contexts. Based on the review's recommendations, some urban areas have been removed from the map to ease development restrictions and a new edition of the map for bushfire prone areas is currently being developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) [92].

#### 4. Discussion

Using the example of spatial planning and wildfire risk management systems, this study revealed that the path to greater policy integration for DRR is grounded on the development of common knowledge, a cross-disciplinary understanding, and agreed policy goals between different policy sectors. With time these developments translate into new institutional arrangements and instruments that integrate the work and decision-making processes of different sectors, as conceptualized by the framework of six trajectory phases towards policy integration developed by this research.

The first phase identified corresponds to the similar independent sectorial origins of wildfire management and planning systems in Victoria and WA, which were formalised in an era associated with the establishment of state authorities and the defining of governmental roles. The sectorial origins were likely to have been influenced by several factors, including the dominance of a modern worldview, the limited availability of equipment and infrastructure, and a growing population that required services and housing [12]. Furthermore, several extreme wildfires occurred during this period in both cases, including Black Friday wildfires that impacted Victoria in 1939 and a series of extreme fires that impacted south-west WA in 1960–1961. These events and the subsequent inquiries led to key changes to wildfire management practice and raised awareness about the importance of wildfire prevention including the interconnections between wildfire and the design and location of settlements.

The second phase of policy integration identified is characterised by the progressive development of knowledge about spatial planning's role in wildfire DRR, from an emergent concern to the first attempts to provide guidance and standards for operationalisation. These findings indicate the emergence of common knowledge regarding the need for an integrated approach and a cross-disciplinary understanding, which Djalante et al. [32] and Candel and Biesbroek [29] argue is a critical dimension of integration. Large wildfire events and subsequent inquiries were found to be a key driver for wildfire management reform and for advancing policy integration between the sectors of wildfire management and spatial planning. Furthermore, experiences and knowledge from other contexts also influenced these changes, including an international trend from disaster management and response towards preventive measures and DRR. Interestingly, changes in WA policy developments to progress integration between the two sectors occurred later than in Victoria and were based on the knowledge and practices of the eastern Australian states. This suggests that as WA had not experienced a significant wildfire event during the 70s–90s, there was not the same impetus to undertake policy reforms during this period as in the case of Victoria. This reinforces the role of disaster events as a catalyst for advancing policy integration between these once independent sectors.

The third phase of integration identified was the inclusion of wildfire considerations and knowledge into local plans. The first local planning schemes and rural and regional strategies that integrated wildfire protection measures were emerging during this period for locations that were renowned for wildfire activity in both Victoria and WA. The policy developments of this phase illustrate how the spatial planning systems started to progressively integrate wildfire considerations into local planning instruments that operationalised wildfire DRR mechanisms to individual developments via planning approval processes. These local examples were forerunners in the establishment of mixed policy

instruments that cut across the sectors and governing scales. Furthermore, these instruments set the basis for future policy integration developments that relied upon the inclusion of wildfire management sectorial advice into planning decisions for wildfire-prone areas. These changes again demonstrate that inquiries following large wildfire events have been a key driver for spatial planning changes to integrate wildfire considerations in decision-making processes, illustrating the system's institutional learning capacity as another key integration dimension [32].

The introduction of state-level institutional arrangements for wildfire integration into the planning system in both Victoria and WA, identified as the fourth phase of policy integration, was the culmination of the experience gained from several wildfire events and wildfire behaviour knowledge being transferred, tested and applied in spatial planning contexts. The development of cross-cutting policy instruments acknowledged spatial planning's importance for wildfire mitigation, establishing clearer frameworks and procedures to identify and treat wildfire risk and to integrate the wildfire management agencies' expertise into planning. Furthermore, wider institutional changes and planning systems' re-structuring provided the opportunity to implement wildfire-related changes based on accumulating knowledge and local experiences. Overall, the state-level institutional arrangements in both cases initiated the alignment of planning and wildfire management institutions, interacting vertically, horizontally and functionally, which is considered a key dimension of integration [22,29,32].

The results illustrated how a more coordinated approach to decision-making represented the fifth phase of integration. This phase represents an acceleration of integration between the spatial planning and wildfire management sectors, as the expertise of actors from one policy sector is formally integrated into the instruments and decision-making processes of another sector. Furthermore, structural changes during this phase promoted the systematic and centralised assessment of wildfire risk to inform integrated decision-making. This strengthening of cross-institutional arrangements and the sharing of more consistent data for evidence-based decision-making can be considered a key dimension of integration. Furthermore, these changes demonstrate that post-incident inquiries and research facilitate institutional learning and policy reform. This relates to another key dimension of integration being the role of institutional learning for the readjustment of policy goals and redesign of instruments [29,32].

Finally, the sixth phase of policy integration identified in the study indicates an increasing recognition of the need to consider the different and dynamic spatial and temporal dimensions when integrating wildfire management and spatial planning. The consideration of the multiple scales of space and time in which actions can be taken is considered herein as a key dimension of effective integration [22]. It must be noted that this phase of integration is still in a nascent stage and that the spatial planning systems in Victoria and WA are still rigid and limited in their integration of the different spatial and temporal scales of wildfire risk reduction. More sophisticated approaches are still needed in both cases. For instance, further recognition of the systems' different dynamic spatial scales could translate into a system that more effectively directs new development to suitable locations and considers context-specific nuances. Changing weather conditions – affected by long-term trends like climate change; medium-term ones like droughts; and very short-term ones such as the temperature, humidity and wind on a given day – are not considered by either state's planning system. Acknowledging that weather conditions and available fuels – influencing fire behaviour – dynamically vary through time, there is a need to increase the adaptability of the planning system to consider the temporal dimension of wildfires and their changing behaviour. Exploration of more sophisticated models for wildfire risk assessment between forestry and planning agencies are currently taking place in Victoria, although their outcomes are uncertain. In WA, the need to better integrate the temporal dimensions of wildfires and vegetation changes for spatial planning is an area that has not received sufficient attention.



Furthermore, more consideration needs to be given to future climate change impacts and wildfire risk at the higher strategic planning levels to determine which areas are suitable for development, given that many areas not currently considered wildfire-prone are likely to become so as the climate changes.

## 5. Conclusion

Through a historical comparative case study of two Australian states' spatial planning and wildfire management systems, this qualitative study has contributed to DRR research by developing a conceptual framework for the trajectory towards policy integration, which consists of six phases. The first one corresponds to the *independent origins of spatial planning and wildfire management systems*, associated with the establishment of an archetypal spatial planning system and a wildfire management system focused on response activities. These early stages set the institutional bases for spatial planning and wildfire agencies' current ways of working. The second stage corresponds to *developing common knowledge and cross-disciplinary understandings*, which is identified as the first indication of integration. This phase is characterised by increasing awareness of spatial planning's potential for wildfire risk reduction and the need for cross-sectoral collaboration. Grounded on the development of cross-disciplinary understandings, the third stage of integration is the *inclusion of wildfire considerations and knowledge into the planning system* through local instruments. Local initiatives are exemplars in the operationalisation of seminal policy instruments that cut across the sectors. The fourth stage distinguished is *formalising state-level institutional arrangements to align the work of spatial planning and wildfire management agencies* based on the culmination of experience gained from several wildfire events and knowledge being transferred, tested and applied to spatial planning contexts. This phase marks the start of the formal alignment of spatial planning and wildfire management institutions, with policy instruments and actors interacting vertically, horizontally, and functionally. The fifth phase identified corresponds to *integrating key decision-making processes within and between agencies* through the delineation of clearer roles and responsibilities of the wildfire management agencies in the planning processes, and in a more centralised approach to hazard identification, referral advice and mapping. This phase's changes strengthened cross-institutional arrangements, data sharing and the formalization of wildfire expertise into planning decision-making. Lastly, the sixth phase of the ongoing trajectory towards integration identified is *recognising the systems' different dynamic spatial and temporal scales*. This is considered an indication of an emergent move from the traditional static hazard mapping and spatial planning towards more sophisticated approaches that allow greater consideration of the different landscape scales, local context, and the dynamic spatial and temporal dimensions of wildfire risk.

The analysis demonstrates that development of these case study subjects towards the integration of spatial planning and wildfire management systems follow a similar trajectory (sequencing of events), which have been influenced by similar trends, underpinning conditions and events (causal mechanisms). It is suggested that changing international spatial planning and disaster policy trends have, and continue to, influence approaches towards spatial planning in wildfire-prone areas. Demographic changes and pressures to develop in WUI areas are recognised as key determinants of wildfire risk and will continue to present a challenge for wildfire management agencies and spatial planning decision-makers, compounded by the climate change impacts of higher fire danger conditions. Learnings from past experiences, accumulative knowledge, and policy reviews of systems' limitations have also influenced changes. In particular, this study has shown that inquiries and research following large wildfire events are a key driver for spatial planning changes, playing a critical role in the systems' institutional learning and instrumental adjustments.

Evidence emerging from the case studies also highlights key

challenges for integration, historical and current. This historical examination shows that the lack of common wildfire knowledge and cross-sectoral understandings about the mutual dependencies of spatial planning and wildfire risk management is a barrier for the integration of the two policy sectors. Furthermore, the absence of formal arrangements for integrated decision-making, different sectoral priorities and operational scales, and diverging institutional cultures can limit the integrative capacity of agencies. Shifting to integrated DRR approaches involves changing the ways disasters are dealt with, and learning from different disciplines, contexts and events. In disaster-prone scenarios, as in any other context, adjusting to changing conditions and learning from experience is inherent to the policy cycle. This paper has highlighted that wider institutional changes, independent reviews and systems' restructuring provide an opportunity to implement changes and develop cross-cutting instruments that facilitate integration across traditionally, independent sectors. In concluding, it is suggested integrated disaster policy approaches are becoming increasingly critical as we are faced with more frequent and complex hazard events. Further research into the factors that enable or constrain policy integration in a range of DRR contexts in practice is therefore needed.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

This research is supported by an scholarship from the Chilean Agencia Nacional de Investigación y Desarrollo, Becas Chile program. This research is supported by a scholarship from the Universidad del Desarrollo. This research is supported by an Australian Government Research Training Program Scholarship.

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