

ABSTRACT

Climate change is a material threat to Australia's economic, social and environmental interests. Strong emergency management frameworks that enable agile responses to these threats are an important element to ensure a resilient economy. This paper considers recent blue green algae outbreaks in the Murray Darling Basin and considers some of the limitations to effective prevention, preparation, response and recovery. This paper proposes an alternative model that includes the responsibilities of the Commonwealth and the state and territory governments in the management of the basin's resources.

Blue green algae in the Murray Darling Basin: a case for Commonwealth leadership

Dr Tim Clune¹ and Associate Professor Michael Eburn²

1. La Trobe University, Melbourne, Victoria.
2. Australian National University, Canberra, Australian Capital Territory.

Submitted: 20 December 2016. Accepted: 24 April 2017.

Introduction

Australia's *National Strategy for Disaster Resilience* (Attorney-General's Department 2011) outlines how extreme environmental events have an impact on 'people, the economy, our infrastructure and the environment'. These events are projected to increase in frequency and severity with climate change. The strategy identifies environmental events as issues of significance for their long-term impacts. Although described narrowly for the purposes of disaster relief in Australia (Attorney-General's Department 2012, p. 6), it is useful to consider a broader, international view of disasters as events that overwhelm the response capacity of the community (Coppola 2015, p. 33). In this context it is not only sudden-onset events such as fires, floods, storms and cyclones that are identified as natural disasters, (Attorney-General's Department 2012, p. 6), 'creeping disasters', which arise through the prolonged degradation of the community's capacity to respond (Coppola 2015, p. 33) are included. In this way, the broad-based blue green algae (BGA) contamination of the waters of the Murray Darling Basin (MDB) is a slow-forming hazard that is not covered by current natural disaster recovery strategies and yet it is projected to increase as a negative consequence of climate change (Baldwin 2016).

The MDB is located in south-eastern Australia and includes the Murray River (2530km) and the Darling River (2740km); Australia's two longest rivers (Bureau of Meteorology 2015). The topography of the MDB is predominantly low-lying or flat (except the mountain ranges to the east and south-east) and features slow, meandering waterways (Murray Darling Basin Authority (a) n.d.). Rainfall in the MDB is highly variable with average annual rainfall varying from 1500mm in the east to less than 300mm in the west (Murray Darling Basin Authority (a) n.d.). The semi-arid climate of much of the basin coupled with the topography results in high evaporation rates, with 94 per cent of rainfall in the MDB consumed by plants or lost to evaporation (Murray Darling Basin Authority (a) n.d.). Climate change is projected to exacerbate this variability with rainfall projected to decline by 4 per cent and runoff by 12 per cent across the MDB by 2030 (CSIRO 2011).

The MDB occupies 14 per cent (1,059,000 km²) of Australia's land area and contains 10 per cent of Australia's population. It contributes significantly to the Australian economy (Australian Bureau of Statistics 2008). It comprises parts of Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia – known collectively as 'the Basin States' (*Water Act 2007* (Cth) s 4). Approximately one third of Australia's agricultural

production occurs in the MDB, including 50 per cent of Australia's irrigated produce estimated to be worth \$6.7 billion annually (Murray Darling Basin Authority (b) n.d.). Further, the diverse geography, climate, environment and internationally recognised wetlands of the MDB contribute millions of dollars annually from tourism to regional economies (Department of Environment and Energy (a) n.d., Murray Darling Basin Authority (b) n.d.).

BGA events occur naturally as a result of low stream flows, extended periods of warm weather and the entry of nutrients into waterways as a consequence of adjacent urban and agricultural land-use and stormwater flows (Department of Environment and Energy (b) n.d.). The impact of BGA contamination presents a threat to public health and local economies that rely on the waters of the basin to meet 'critical human water needs' (*Water Act 2007* (Cth) s 86A). BGA can, but does not always, produce toxins that cause a variety of conditions for humans, pets and livestock. These range from skin irritations through to liver damage if ingested in sufficient quantities (NHMRC 2008, NHMRC/NRMMC 2011). BGA can also block irrigation infrastructure reducing irrigation efficiency and productivity (Agriculture Victoria 2016).

In recent history the MDB has experienced significant BGA events in 1983, 1991, 2009, 2010 and 2016 (Murray Darling Basin Authority (c) n.d.). While the first four events were related to low stream flows as a consequence of drought, the nature of the bloom in 2016 was different in that it was related to elevated water temperature. This highlights the significance for future climate scenarios that are anticipated to increase as the climate continues to change and BGA events become more frequent in the MDB (Baldwin 2016).

BGA events are generally resolved by natural events, that is, lower water temperatures or higher stream flows. Consequently, control measures to alleviate BGA generally comprise changes to the management of river flows. This is done through the release of water from upstream storages, avoiding contact with and use of the water until the bloom subsides and, in some limited circumstances, applying algacides to remove the algae (Department of Environment and Energy (b) n.d., Murray Darling Basin Authority (c) n.d., NHMRC/NRMMC 2011).

Given the importance of the MDB to the Australian economy and the increased likelihood of BGA events, it is conceivable that a significant event impacting on the use of the MDB water resources could manifest as a natural disaster. Australian states and territories are generally responsible for all aspects of emergency management, while the Commonwealth contributes financial and non-financial resources in consultation with each jurisdiction (Attorney-General's Department 2012). However, this paper proposes that the Commonwealth has a greater responsibility for all aspects of emergency management by ensuring appropriate prevention of, preparation for, response to, and recovery from events that impact on the use of MDB water resources.

Exercise of Commonwealth control

Access to and the control of MDB water resources to support economic growth and development in the Basin States has been contested since before federation (Kildea & Williams 2010). In 2007, the Basin States and the Commonwealth reached agreement on the management of the MDB. The *Murray Darling Basin Agreement* (the Basin Agreement) is set out in Schedule 1 of the *Water Act 2007* (Cth). The purpose of the Basin Agreement is to:

... promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water and other natural resources of the Murray Darling Basin, including by implementing arrangements agreed between the Contracting Governments to give effect to the Basin Plan, the Water Act and State water entitlements. (Water Act 2007 (Cth))

The Basin Agreement establishes key administrative functions for its implementation including roles, responsibilities and administrative functions for the management of MDB water resources and agreed water-sharing arrangements between the Basin States. To give effect to the Basin Agreement, the Basin States referred relevant legislative power to the Commonwealth. These referrals gave the Commonwealth the necessary constitutional authority to pass the *Water Act 2007* and to establish the Murray Darling Basin Authority (MDBA) (*Water Act 2007* (Cth) ss 9 and 18B, *Australian Constitution* s 51(xxxvii)).

Thus the Commonwealth has legislative authority through the MDBA, to assert control over the MDB water resources. The *Water Act 2007* allows the Commonwealth and the MDBA to address threats to basin water resources and to protect, restore and provide for the ecological values and ecosystem services of the MDB. The aim is to improve water security for all uses of basin water resources (*Water Act 2007* (Cth) s 3).

One key function of the MDBA is:

...to develop, or assist the development of, measures for the equitable, efficient and sustainable use of the basin water resources (including measures for the delivery of environmental water). (Water Act 2007 (Cth) s 172(1)(e))

These objectives are formalised through the *Basin Plan 2012*, which is prepared by the MDBA and adopted by the Minister (*Water Act 2007* (Cth) s 41). The plan details water quality targets, including those relating to BGA in recreational waters, to which the MDBA must have regard when performing its functions (*Basin Plan 2012*, s 9.14(1)). Further, the MDBA 'must' implement an emergency response to any event in which triggers or thresholds relating to water quality are exceeded (*Water Act 2007* (Cth), s 86F(1)).

These provisions demonstrate that the management of the MDB, including management of any emergency that may impact on the waters of the MDB, is a matter of Commonwealth responsibility. Even without those provisions it is arguable that, in the case of a significant BGA event manifesting as a natural disaster, the Commonwealth is empowered through the Executive Powers prescribed by s61 of the *Australian Constitution*, to assume control over natural disasters whether it has legislative authority or not (Eburn 2011, p. 89). It follows therefore, that the Commonwealth should assume control of the entire emergency management spectrum—prevention, preparation, response and recovery—with respect to MDB water resource outcomes to ensure the alignment of both short-term incident management response actions as well as longer-term disaster resilience objectives (Coppola 2015, p. 14). A consequence of this is the establishment of minimum standards to inform state-based catchment management activities.

Managing the impacts of BGA in the MDB

BGA events are not unanticipated in the waters of the MDB, having been recognised since the times of early explorers (Murray Darling Basin Authority (c) n.d.). In 1994 the then Murray Darling Basin Ministerial Council adopted an Algal Management Strategy to inform management of these events as part of a broader natural resource management strategy (Murray Darling Basin Ministerial Council 1994). The strategy was based on four objectives:

- reducing nutrient concentrations in the streams and reservoirs of the basin
- improving stream flows and flow management
- increasing community awareness
- research and development.

A key element of the strategy was the operating presumption that while a coordinated, whole-of-catchment response was required to address the underlying issues of BGA, the role of the Commonwealth related largely to leadership and relationships. The Basin States were responsible for the activities that directly impacted on water quality such as catchment management and flow enhancement (Murray Darling Basin Ministerial Council 1994).

Despite the passage of the *Water Act 2007*, the response to BGA threats remains very much driven by the Basin States. Primarily the response relates largely to assessing the threat to the waterway over which the state has management control, identifying and monitoring the development and progress of blooms and notification of impacted water users and regulatory authorities, including those in other jurisdictions, that the water is not safe for use (New South Wales Department of Primary Industries n.d., Murray Darling Basin Authority

(c) n.d., Victorian Department of Environment, Land, Water and Planning 2016).

Despite the long-held recognition that flow regimes are an important element of the response to BGA events (Murray Darling Basin Ministerial Council 1994, p. 11), the focus of the state-based response to BGA events relates to monitoring algal blooms and informing and enabling communities to avoid contact with contaminated waters (New South Wales Department of Primary Industries n.d., Victorian Department of Environment, Land, Water and Planning 2016). This reflects a lack of capacity to negotiate and coordinate the sharing of large volumes of water to be flushed through the system given the existing water-sharing arrangements between the Basin States (*Water Act 2007* (Cth) Schedule 1, Part XII). It may also reflect concerns relating to limiting future water availability for water users and the potential future economic damage that arises from such actions since water stored for irrigation outcomes is managed at a state level (New South Wales Office of Water n.d.).

Stronger leadership from the Commonwealth

The key question for future management of the MDB is whether the Commonwealth should play a stronger role in the prevention and preparation for, and the response to and recovery from, BGA events in the MDB than it currently does. While this question remains hypothetical for the immediate future, it assumes relevance in July 2019 when, in accordance with the Commonwealth Water Amendment Regulation No. 1 (2012), Victoria will refer relevant legislative powers to the Commonwealth.

BGA events in the MDB impact communities and regional economies and, such is the magnitude of the threat, it requires the intervention of multiple jurisdictions. The risk accruing from BGA is related to water quality and the effects are distributed according to the relative consumption of water rather than the relative state entitlement to the MDB water resource.

The Commonwealth, through the *Water Act 2007*, has assumed a critical role in planning for the sustainable use of MDB water resources and ensuring the implementation of the Basin Plan, particularly as it applies to the maintenance of water quality objectives. Further, as noted, s86F of the *Water Act 2007* requires the MDBA to act to ensure an appropriate response is implemented if objectives are not met (*Water Act 2007* (Cth), s86F(1)). The Commonwealth should take the lead in establishing expectations through the prevention and preparation for BGA events in the MDB as well as the establishment of emergency management priorities for response and recovery from BGA events.

This reflects a significant shift in the relative roles and responsibilities compared with the current operating environment. Specifically, it shifts the Commonwealth from a 'hands-off' leadership role as articulated in the 1994 Algal Management Strategy (Murray Darling

Basin Ministerial Council 1994), to one of leadership and direction of prevention, preparation, response and recovery (PPRR) from BGA events (historically the domain of the Basin States (Geoscience Australia n.d.). Despite the significant shift, many of the structures required for the Commonwealth to achieve this goal already exist, but there is a lack of a suitable framework to ensure integrated outcomes.

A proposed PPRR model for Commonwealth leadership

The *National Disaster Response and Recovery Arrangements* (NDRRA) assert that effective emergency responses to natural disasters are underpinned by adequate PPRR activities, supported by an all-agencies approach involving government and non-government entities (Attorney-General's Department 2012, p. 13). A PPRR model to enable Commonwealth leadership is proposed. This model highlights elements that are in existence, as well as gaps that would need to be resolved.

Prevention

There are adequate existing elements to enable effective prevention of water quality incidents in the MDB, including:

- Legislation - the Commonwealth has asserted control over MDB water resources and Basin States have referred specific powers to enable the implementation of Commonwealth authority (*Water Act 2007* [Cth]).
- Basin Plan - water quality risks have been identified, resource plans and catchment targets have been implemented, extraction and trading rules have been established and enforcement mechanisms recognised (*Basin Plan 2012*).
- Environmental watering - water for the purposes of enhanced environmental outcomes in water-dependent ecosystems is held by Commonwealth (Commonwealth Environmental Water Holder n.d.) and state and territory (Victorian Environmental Water Holder n.d.) governments.
- Land management programs - federally funded programs, such as Landcare, actively rehabilitate landscapes and protect catchments in the MDB (National Landcare Programme n.d.).
- Incentives and inducements - by virtue of the referral of powers from the states, the Commonwealth is empowered to provide for the development of programs to support protection of the MDB.

Preparation

Existing within-jurisdiction response protocols (for example the Victorian Blue Green Algae Coordination Framework (Victorian Department of Environment, Land, Water and Planning 2016)), enable effective management

of incidents. However, these state-based approaches are less applicable when multiple jurisdictions are effected. Although information is shared between Basin States as BGA events increase in size (Murray Darling Basin Authority (c) n.d.), decision-making responsibility remains with the individual Basin State members.

Additional elements that would enhance preparation outcomes are:

- harmonisation of incident response through establishment of uniform protocols, consistent with the Australasian Inter-service Incident Management System (AIIMS)¹ framework that establishes clear coordination, control and command responsibilities, could improve the effectiveness of cross-jurisdictional incident response (Australasian Fire and Emergency Services Authority Council 2013).
- inter-agency planning to ensure appropriate understanding of the protocols and the respective roles and responsibilities of coordination, control and command agencies.

Response

Since the Commonwealth does not currently lead the response to BGA events in the MDB, the authority to develop and implement Commonwealth-led incident protocols would need to be established and agreed with the Basin States. As part of that agreement uniform response protocols consistent with the AIIMS framework are required for implementation. A key element is the adoption of agreed emergency management priorities that reflect the imperatives of the Commonwealth as opposed to those of individual states.

Recovery

Existing elements to enable effective recovery from significant water quality events in the MDB, including the NDRRA (Attorney-General's Department 2012) would be markedly enhanced by agreed response protocols implemented at a local, regional and state and national scale. These are represented as Level 1, Level 2 and Level 3 in Table 1.

A Commonwealth-led integrated response

Underpinning an integrated response to BGA events in the MDB consistent with the AIIMS framework is the assertion of incident control through a central body (Australasian Fire and Emergency Service Authorities Council 2013). The MDBA is required to set water quality trigger points at which water becomes unsuitable for human needs (*Water Act 2007* [Cth] s86B(1)(c)). In addition, in the event that water quality trigger points are

¹ Australasian Inter-service Incident Management System. At: <http://trove.nla.gov.au/work/33563486?selectedversion=NBD43069108>

reached, it must formulate an emergency response to ensure water is available and take the necessary action to implement a response (*Water Act 2007* (Cth) s86F(1)). Therefore it is reasonable that the MDBA would assume the role of the control agency.

Applying the AIIIMS framework in this context enables the implementation of an integrated response that is flexible, appropriately resourced and effective across multiple jurisdictions. The scenario outlined in Table 1 shows how the integrated response could be applied during a BGA event.

A uniform incident response protocol based on the AIIIMS framework could be established under the control of the MDBA as the control agency for water quality incidents in the MDB. Incident control would be exercised through the MDBA, leveraging existing response resources where appropriate. For example, for a Level 1 event, state-based response entities would ensure the delivery of outcomes, as is currently the approach. However, incident control objectives would be determined in accordance with agreed MDBA protocols. Specialist MDBA regional and national incident controllers would be appointed for Level 2 and Level 3 events. It is important to note that for Level 2 and Level 3 incidents, some sectorisation of the incident (eg NSW sector, Victorian sector etc) may be considered to ensure that objectives are met in the most effective manner (Australasian Fire and Emergency Service Authorities Council 2013). Further, in each of these scenarios, command of personnel would remain with the state-based entities providing the resources.

The Ministerial Council would provide the coordination required for an effective incident response. Each Basin

State is represented on the Ministerial Council, as such, it is the appropriate body to ensure the availability of resources to meet the complexities of incidents and the appropriate escalation of incident response, including the declaration of a Level 3 emergency situation.

Conclusion

Blue green algae events in the MDB are not unanticipated and are expected to increase in severity and prevalence. They present a material threat to regional communities and economies and, by extension, the national economy. Consequently, the loss of access to MDB water resources due to contamination by BGA could manifest as a natural disaster. The Commonwealth has assumed responsibility for the management of water quality in the MDB and importantly, enhancing the resilience of current management. For the Commonwealth to fulfil this obligation and encourage greater resilience of basin communities to the BGA events, existing approaches must be changed. While the current prevention mechanisms are appropriate to mitigate the threat of BGA, preparation, response and recovery approaches are not. The current state-based approaches should be set aside and recast under the control of the Commonwealth, coordinated by the Murray Darling Basin Ministerial Council and under the control of the MDBA. Aligning this central coordination and control of the Commonwealth entities with the command of personnel at the state level provides the effective management of BGA incidents across multiple jurisdictions and, importantly, meets the objectives of the nation in managing these events in the waters of the MDB.

Table 1: Summary of the implementation of MDBA control over an emerging BGA event in the MDB.

Incident Response Level	Scenario	Incident Control
Level 1 Local Incident Response	BGA is detected in the upper reaches of the MDB. The BGA is monitored and community safety managed at the local level with the MDBA providing oversight of the incident.	A local incident control team is established. Incident control is provided using established, state-based local resources. ¹ MDBA Level 1 incident response protocols adopted.
Level 2 Regional Incident Response	The BGA bloom spreads to a number of storages in the upper Murray River effecting water resources shared between NSW and Victoria. The MDBA Regional Incident Controller assumes control, directing local resources to manage the response to meet regional objectives.	An MDBA Regional Incident Control Centre is established. MDBA Level 2 incident response protocols adopted.
Level 3 National Incident Response	The BGA bloom extends along significant reaches of the MDB reducing the quality of water shared by more than two states. The Ministerial Council ² declares a Level 3 emergency and a National Incident Controller is appointed and assumes control of the incident. ³ At this point the incident is of national significance with a long and protracted recovery period anticipated.	The MDBA establishes a National Control Centre. MDBA Level 3 incident response protocols are initiated and the incident is managed in accordance with national interest objectives.

1 See for example New South Wales Department of Primary Industries (Water), Algal Contacts, Regional Algal Coordinating Committees, www.water.nsw.gov.au/water-management/water-quality/algal-information/algal-contacts.

2 *Water Act 2007*, Schedule 1, s9(a).

3 It is important that for the incident to escalate to Level 3 it requires an appropriate body that can declare the shift (Australasian Fire and Emergency Service Authorities Council 2013, p. 23).

References

- Agriculture Victoria 2016, *Blue green algae and Irrigation Water*. At: www.agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/irrigation/blue-green-algae-and-irrigation-water [27 March 2017].
- Attorney-General's Department 2011, *National Strategy for Disaster Resilience*, Attorney-General's Department, Canberra.
- Attorney-General's Department 2012, *Australian Natural Disaster Relief and Recovery Arrangements, Determination*, Attorney-General's Department, Canberra.
- Attorney-General's Department 2014, *Australian Government Disaster Response Plan: COMDISPLAN*, Attorney-General's Department, Canberra.
- Australasian Fire and Emergency Services Authorities Council 2013, *Australasian Interservices Incident Management System – AIFMS (4th edition)*.
- Australian Bureau of Statistics 2008, *Water and the Murray-Darling Basin - A Statistical Profile, 2000-01 to 2005-06*. At: www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0.55.007 [2 October 2016].
- Baldwin D 2016, *Are Toxic Algal Blooms The New Normal For Australia's Major Rivers?*, *Ecos* (18 May 2016). At: <https://blogs.csiro.au/ecos/toxic-algal-blooms-new-normal-for-australias-major-rivers/> [2 October 2016].
- Basin Plan 2012 (Cth). At: www.legislation.gov.au/Details/F2017C00078 [9 April 2017].
- Bureau of Meteorology 2015, *National Water Account 2015*. At: www.bom.gov.au/water/nwa/2015/mbd/index.shtml [27 March 2017].
- Commonwealth Environmental Water Holder. At: www.environment.gov.au/water/cewo [2 October 2016].
- Commonwealth of Australia Constitution Act 1900 (Cth). At: www.legislation.gov.au/Details/C2013Q00005 [5 April 2017].
- Coppola D 2015, *Introduction to International Disaster Management*, Oxford, England.
- Department of Environment and Energy (a), *Australia's Ramsar Sites*. At: www.environment.gov.au/water/wetlands/publications/factsheet-australias-ramsar-sites [2 October 2016].
- CSIRO 2011, *South Eastern Australian Climate Initiative, Understanding future changes in climate and stream flow*. At: www.seaci.org/publications/documents/SEACI-2Reports/SEACI2_Factsheet4of4_WEB_110714.pdf [27 March 2017].
- Department of Environment and Energy (b), *Blue Green Algae (Cyanobacteria) And Water Quality Fact Sheet*. At: www.environment.gov.au/water/quality/publications/factsheet-blue-green-algae-cyanobacteria-and-water-quality [2 October 2016].
- Eburn M 2011, *Responding to Catastrophic Natural Disasters and the need for Commonwealth Legislation*, *Canberra Law Review*, vol. 10, issue 3.
- Emergency Management Manual Victoria 2016, *Part 3 State Emergency Response Plan*. At: www.emv.vic.gov.au/policies/emmv [2 October 2016].
- Geoscience Australia, Emergency Management 2016, *Response, Role of the States and Territories*. At: www.ga.gov.au/scientific-topics/hazards/emergency-management/response [2 October 2016].
- Kildea P & Williams G 2010, *The Constitution and the management of water in Australia's rivers*, *Sydney Law Review*, vol. 32, p 595.
- Murray Darling Basin Authority (a). At: www.mdba.gov.au/discover-basin/landscape/climate [27 March 2017].
- Murray Darling Basin Authority (b), *Basin Economy* At: www.mdba.gov.au/discover-basin/people/economy-basin [2 October 2016].
- Murray Darling Basin Authority (c), *How Blue Green Algae Blooms Are Handled*. At: www.mdba.gov.au/managing-water/water-quality/how-blue-green-algae-blooms-are-handled [2 October 2016].
- Murray Darling Basin Ministerial Council 1994, *Algal Management Strategy for the Murray Darling Basin*. At: www.mdba.gov.au/sites/default/files/pubs/the-algal-management-strategy.pdf [2 October 2016].
- National Health and Medical Research Council (NHMRC), *Natural Resource Management Ministerial Council 2011, Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, Commonwealth of Australia, Canberra.
- National Health and Medical Research Council (NHMRC) 2008, *Guidelines for Managing Risks in Recreational Waters* At: www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh38.pdf [2 October 2016].
- National Landcare Programme. At: www.nrm.gov.au/national-landcare-programme [2 October 2016].
- New South Wales Department of Primary Industries (Water), *Algal Contacts, Regional Algal Coordinating Committees*. At: www.water.nsw.gov.au/water-management/water-quality/algal-information/algal-contacts [2 October 2016].
- New South Wales Office of Water, Water Licensing. At: www.water.nsw.gov.au/water-licensing [2 October 2016].
- Victorian Department of Environment, Land, Water and Planning 2016, *Blue-Green Algae Circular 2015-16, Co-ordination Framework*. At: <http://nla.gov.au/nla.obj-298267678/view> [2 October 2016].
- Victorian Environmental Water Holder. At: www.vewh.vic.gov.au/about-vewh [2 October 2016].
- Water Act 2007 (Cth). At: www.legislation.gov.au/Details/C2016C00469 [5 April 2017].

About the authors

Dr Tim Clune is at La Trobe University Business School. His primary research interests relate to the effective management of sustainability threats through sound governance.

Associate Professor Michael Eburn is at the ANU College of Law. His primary research interests are in the law and its application to emergency services and emergency management.