Issues Paper

Using signage to promote water safety and prevent aquatic related injuries in Australia: An examination of the key issues

Executive Summary

Signage is a simple, cost effective and extremely valuable tool for injury prevention. Through its provision of information about risks and hazards associated with specific areas, locations or activities, signage is essential for thorough and effective water safety practice. The use of symbols in signage facilitates the rapid transmission of information in a manner that often transcends language barriers so that the meaning and purpose of signs can be conveyed to a diverse audience. Signs work to minimise risk by providing information which aims to subsequently affect behaviour.

This paper identifies issues for the provision and use of water safety signage at all aquatic environments that people access for recreational activity. It is directed at policy makers, researchers, public awareness campaigners producing guidance material, and for managers of aquatic environments.

There were four general areas identified where improvement or future action is required for signs to be effectively integrated into water safety practice. These are: improving the evidence base; promoting the use of a risk management approach to signage among managers of aquatic locations; implementing public awareness campaigns; and strengthening Australian Standards.

1. Improving the evidence base

There is a lack of evidence supporting the effectiveness of water safety signs for improving safety (including reduction of drowning). This paper highlights the need for further research on water safety signage, which a literature review found to be very limited to date (the most relevant available material was predominantly related to road signage).

Despite this gap in knowledge, several issues pertaining to the effective use of signage were identified in this investigation, associated with both the environments in which signs are placed and the people

whose behaviour signs are intended to affect. These issues include the placement, visibility, prevalence (i.e. sign pollution) and enforcement of signs and their messages, as well as the impact of personal values and past experiences on the manner in which individuals engage with signage.

Recommendation: There is a need to improve our understanding of the factors that impact on a person's behaviour following exposure to water safety signage. Specifically:

- **Compliance:** Do factors such as personal values and past experiences impact upon the likelihood of a person following a sign's advice?
- **Comprehension:** Do people understand a sign's meaning and does this impact upon behaviour change?
- **Placement:** Does proximity to the hazard increase recognition of signage and thus effectiveness?
- **Construction:** What role do factors such as size, design, luminosity, visibility play in improving comprehension of signage?
- **Maintenance:** Are well maintained signs more likely to be recognised and thus complied with?
- **Enforcement:** Is signage alone effective or do enforcement measures such as fines or patrols increase the likelihood of compliance?

2. Management of aquatic locations

It is necessary that water safety signage is of a high standard across aquatic locations not only for the prevention of injury, but also because it can have legal implications associated with public liability and duty of care for persons managing aquatic environments. This paper uses case studies of legal action to demonstrate the implications of signage for local government areas in particular.

Direct reference to water safety signage in State and Territory legislation is limited. As a result, this paper draws upon Australian Standards (AS), which aim to ensure the consistency and effectiveness of safety symbols and signage.

Signage forms just one part of the risk management process. It is important to note that signage as a sole measure is not always effective for improving water safety and preventing injury. A best practice approach to water safety uses a risk management approach that follows the hierarchy of control principles to inform decisions regarding the use of water safety signs.

Recommendation: A risk management approach that follows the hierarchy of control principles should be used to inform decisions regarding the use of water safety signage when there is a need to warn the public of a hazard and/or risk.

Recommendation: Systems should be implemented to record and analyse information on injuries and incidents which occur at aquatic environments.

3. Public awareness

This issues paper highlights the need for the development of strategies which improve the effectiveness of water safety signage and educate the public about the meaning and purpose of signage. In order for signs to affect behaviour, they must be understood by their intended audience. Effective understanding

relates to issues of consistency and the public's comprehension and recognition of signage, which are best developed through education campaigns.

Recommendation: Public education campaign(s) should be undertaken to promote awareness and understanding of water safety signs and compliance with such signage.

4. Australian Standards (regulatory framework)

The consistent use of signs across Australia will facilitate recognition and understanding, and ultimately, improve the effectiveness of signage for affecting behaviour, minimising risk and preventing aquatic related injury. The Australian Standards and the International Standards provide a regulatory framework that is conducive to achieving this. However, currently AS2416 is not comprehensive and should be updated to include all water safety signs commonly used in Australia. It is also important that all signs are tested for comprehension and recall (as per AS2342) prior to inclusion.

Recommendation: Australian Standard 2416 should include all water safety signs required in Australia.

Recommendation: Australian Standards for water safety signs should be consistent with International Standards. Consistency of Australian and International standards will help improve comprehension of and compliance with water safety signage by overseas visitors.

Thus, by ensuring the following issues are considered it will be possible to improve water safety in Australia and to further prevent aquatic related injury, including drowning deaths:

- Improving the available evidence base on water safety signage
- Ensuring the management of aquatic locations is guided by best practice principles for signage and risk management
- Promoting public awareness of risk and the implications of signage
- Using strengthened Australian Standards to effectively regulate the use of signs.

Contents

Introduction

Signage, when used in conjunction with a risk management plan, forms one component of a comprehensive strategy for preventing aquatic injury, including drowning. Signage works by warning people of the hazards and risks associated with a particular location, activity or behaviour and can be a simple and cost effective means of providing people with information.

The evidence base underlying the use of signs to promote water safety and prevent aquatic related injury is limited. As such, this paper will examine research relating to water safety signage, including its legislative basis and the regulatory framework that applies to water safety signage in Australia. Key issues linked to the use of signage in water safety promotion and aquatic related injury prevention will be identified and discussed, and a best practice approach, based on available evidence, will be proposed.

Aims

This paper aims to:

- Examine the role of signage in promoting water safety and preventing aquatic related injury, including drowning, in public aquatic environments;
- Identify key issues associated with using signage to promote water safety and prevent aquatic related injury, including drowning, in public aquatic environments; and
- Make recommendations for improving the use of signage to promote water safety and prevent aquatic related injuries including drowning, in public aquatic environments.

Safety signage in Australia

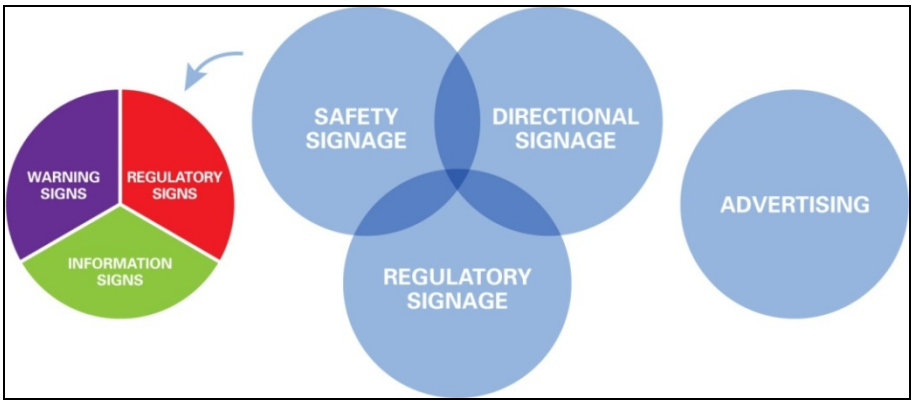


Figure 1 The interaction of different types of signage

Below are visual examples of the different forms of safety signage that can be used at aquatic environments.

Regulatory Signage

Regulation symbols are used on signs with a red border and bar on a white background. These signs contain instructions which must be complied with; failure to do so is a law breaking offence and a breach of safety [1].

No Swimming (AS2416, sign 202) [2]

Safety Signage

Warning symbols are used on signs with a black border on a yellow background, advising of a particular hazard or hazardous condition, or that an activity is not recommended [1].

Shallow water (AS2416, sign 228) [2]

Information Signage

Information signs are used to identify areas of a waterway that are suitable for certain activities [1].

Swim between the flags [3]

Directional Signage

Directional signs provide information for users on the location of places and things.

First Aid (AS1319, sign 471) [4]

Analysis

The analysis section of this report includes the following areas:

- Legislative and regulatory frameworks for water safety signage
- Key issues associated with signage
- Case study: Uzabeaga v Town of Cottesloe [2002]
- Best practice approach to water safety signage, including a hypothetical case study.

Legislative and regulatory frameworks for water safety signage

In Australia, there are legislative and regulatory frameworks which apply to water safety signs. These include legislation and standards which are sometimes referenced in legislation. The regulation of signage throughout Australia is vital, as signs that are "…improperly designed, constructed, located, or concentrated in large numbers, can be hazardous to public safety and welfare…" (pg 257) [5].

Legislation

Local Government legislation provides local councils in Australia with powers to regulate certain activities or behaviours in public spaces under their control, including aquatic environments. Signs are frequently used to exercise these powers. For example, Section 633 of the NSW Local Government Act provides powers to regulate bathing and other water-based recreational activities, allowing councils to "…erect a notice: on land vested in or under the control of a council, or on any other land, with the consent of the person who owns or controls the land…" (s633[3]) [6].

Activities and behaviours that might be prohibited or restricted in public aquatic environments may include swimming or fishing, diving from rocks, consuming alcohol, and the use of watercraft and other water-based equipment [7].

Whilst not always explicit in the legislation, all State and Territory local governments have the ability to install signage (which may include water safety signage where relevant) under their broad powers to ensure good government under the relevant Local Government Act [8] [6] [9] [10] [11] [12] [13] [14].

Employers at public swimming pools and aquatic facilities, as well as persons in control of such workplaces, may also erect signs to regulate behaviours and activities and promote safe experiences. This might include signage warning of hazards such as slippery floors and changing water depths, and prohibiting behaviours such as running, diving, and consuming alcohol. Signage can also direct people to the location of emergency or first aid equipment, exits and entry points.

Signage at these facilities could be used by employers and persons in control of workplaces in conjunction with a risk management approach (where all higher order controls have been exhausted) to fulfil their legal responsibilities, particularly in relation to duty of care and minimising risks to health and safety for both employees and members of the public (Appendix 1: Legislation). Thus, signage may also mitigate risk from a manager/owner perspective with respect to civil liability [15].

Australian Standards

Standards Australia (SA) is a statutory body that produces Australian Standards (AS) which aim to ensure consistency in signage throughout Australia by producing guidelines for their design and provision.

Australian Standards are prepared by committees of experts from industry, government, consumer and other relevant sectors.

The information published in a Standard is a consensus of the views of representative (industry, community, government and safety organisations) interests. AS also take into account comments received from the public (within Development Phases) [16]. AS are periodically reviewed, making them easier to amend than legislation and, therefore, very important within the regulatory landscape. Though not legislative documents, AS may be referenced within State and Territory legislation, thus becoming part of legislation.

Australian Standards establish a nationally consistent set of guidelines surrounding the appearance and provision of water safety and other safety signage in general. Standards relevant to the issue of water safety signage and signage for aquatic environments include:

- AS2416 – Design and Application of Water Safety Signs
- AS1319 – Signs for the Occupational Environment
- AS2342 – Development, testing and implementation of information and safety and symbolic signs.
- AS/NZS4360 – Risk Management.

In 'AS2416 Design and Application of Water Safety Signs' [2] there are a number of conventions based on wider signage use (Appendix 3: AS2416 - Design and Application of Water Safety Signs (précis))[17] . These include the use of particular colours and shapes to differentiate meaning.

All signs used in AS are tested for a determination of need and for comprehensibility prior to being included in a standard. The selection and testing of signs is described in AS2342 (Appendix 2: AS2342 – Development, testing and implementation of information and safety symbols and symbolic signs (précis)). Any sign that is in an Australian Standard should have been tested and 85% of the population should know its meaning or be able to recall its meaning after being informed of the meaning.

International Standards

International Standards (IS) are developed and published by the International Standards Organisation (ISO). The ISO is a network of the national standards institutes of 157 countries, with one member per country and a secretariat that coordinates the system [18]. The ISO develops and publishes International Standards on a wide variety of topics, aiming to produce symbols and symbolic signs that have one meaning for each safety sign.

The ISO produces a number of IS relevant to the issue of water safety signage. These include:

- ISO/DIS: 20712-1.2 Water safety signs and beach safety flags – Part 1: Specifications for water safety signs used in workplaces and public areas
- ISO/DIS: 20712-2 Water safety signs and beach safety flags – Part 2: Specifications for beach safety flags – Colour, shape, meaning and performance
- ISO/DIS: 20712-3: Water Safety Signs and Beach Safety Flags – Part 3: Guidance for the use of water safety signs and beach safety flags
- ISO 17398: 2004 – Safety colours and safety signs – classification, performance and durability of safety signs (which is currently in the draft stages of development).

Key issues associated with signage identified via a Literature Review

A literature review was conducted to examine previous research undertaken in the area of water safety signage. The review also aimed to assist in the development of recommendations for improving the use of signage to promote water safety and preventing aquatic related injury, including drowning.

Aims

The aims of the literature review were as follows:

- To examine the issues associated with the provision of water safety signage.
- To discover the extent of research in the area of water safety signage.
- To determine if there was a link made between the provision of safety signage and changes in behaviour.

Methods

An initial review of the literature was undertaken during the period 15-19 October 2007 and yielded few articles related to water safety signage. A further literature review was conducted over the period 13-18 December 2007, expanding the review to explore articles related to signage (not necessarily water related).

The following databases and journals were reviewed:

- Medline (OVID database)
- PsycINFO (OVID database)
- Informit database

The keywords used to search these databases were: recognition, sign, water, safety signage and safety sign.

The terms 'water', 'safety' and 'sign' were initially used to search for literature in Medline (OVID database). The term 'water' with limits to abstract and English language returned 276,235 results, 'safety' returned 169,173 results and 'sign' returned 41,2532 results. When combined, eight documents were found however none were related to water safety.

The terms 'water' + 'sign' were also searched, with 'water' limited to English language and abstract and returned 276,235 results and 'sign' returned 27,724 results. When combined, these two searches resulted in 590 results, however none were directly relevant to this issues paper.

A search of the Medline OVID database using the term 'recognition' as a subject heading returned 219,576 results. The term 'sign' used as a key word returned 40,731 results. These two searches were then combined and returned 152 results. This search was then limited to articles in English which resulted in 146 articles, of which two were related to safety signage.

A search of PsycINFO OVID database using the terms; 'recognition', which returned 59,873 results, and 'sign', which returned 8,911 results. When combined and limited to English, there were 277 results, of which three were related to safety signage.

The Informit database was also searched using the terms:

- 'water' + 'safety' + 'signage' which returned no results.
- 'safety' + 'sign' which returned 9 results, none of which were relevant to this paper.

- 'recognition' + 'sign' which returned 9 results, none of which proved to be relevant to this paper.

From the articles found as part of the literature review and those previously identified, a snowballing technique was also utilised (i.e. a process whereby several key books or articles are chosen, and their reference lists read to find earlier material or further information on the subject area [19]). This technique identified a number of other documents on signage and behaviour which were used in this issues paper. These articles were drawn from such journals as: *Human Factors*, *Journal of Experimental Psychology: Human Perception and Performance*, *Journal of Experimental Psychology: General*, *Behaviour Research Methods, Instruments and Computers* and *Journal of Experimental Psychology: Applied and Tourism Management, Journal of Occupational Health and Safety – Australia New Zealand, International Journal of Behaviour Consultation and Therapy*. These journals were then searched for other articles of relevance to safety signs.

Results

There were three articles on water safety signage found as part of the literature review. This indicates that there has been very little research undertaken on the topic of water safety signage, including people's engagement with water safety signage and the impact of such signage on a person's behaviour. The majority of the literature associated with safety signage focuses on road signs and motorists' engagement with road signs.

The road safety signage literature was also examined for information that may be applicable to water safety signage. Based on this examination, a number of key issues associated with using signage to promote water safety and prevent drowning were identified. These included recognition, understanding, impact on behaviour, placement, size and height of signage, and enforcement and compliance issues. These issues are considered in the next section of this paper.

Recognition of signage

For a sign to be effective it needs to be recognised [20]. Effective recognition of a sign increases the likelihood that a person will act upon the message in the sign [21]. There are two elements to recognition; recognition that the sign is present and recognition of its meaning [20 22].

The manner in which people recognise and engage with water safety signage is an area in which the evidence base is lacking. There has, however, been research into the effectiveness of road signs. Factors that affect recognition of road signs that may also be relevant to water safety signage include:

- Size [20 22-24]
- Legibility [20-22 24-26]
- Comprehension [26 27]
- Visibility in the surrounding environment [20 22-24]
- Personal attributes of the person viewing the sign (including age, eyesight, language skills, and experience) [20 26 28-31]
- Context - location in relation to hazard [21 30 32]

Size

The greater the conspicuousness and legibility of the sign, the more effective it is [20]. Smaller signs have been shown to be harder to find [23].

Legibility

This is related to size, as well as, internal contrast of colours and symbols and luminance (particularly where the sign needs to be seen at night / dawn or dusk [20]). The greater the contrast and luminance, the higher the probability that the sign will be seen and the details discerned [20]. Ageing of a sign may reduce its legibility, as well as time of day (due to shading), position and the surrounding environment. Lambert and Fleury [20] noted that the "…conspicuousness and legibility of traffic signs depends upon their general form, size, and luminance as well as upon their internal contrast…"(p 611).

Comprehension

Comprehension of a sign is a complex issue as there appear to be two stages in a visual search. The first involves the analysis of information in single blocks and the second stage is where information is put together to comprehend meaning [27]. Where there is a single feature used (such as a red item among green items), it stands out and analysis occurs rapidly. However, where there are similar items or multiple items used, time to recognition is increased [27]. Thus, the greater the complexity of the sign, the longer it takes for a person to comprehend its meaning [22 27].

Familiarity with the sign, i.e. the frequency the sign is encountered, also increases the probability of it being understood [25]. Evidence also supports the preferential use of symbols in signs rather than words (as symbols are processed faster) [22 24]. Symbols enable a move away from the need for an explanation in multiple languages and thus improve comprehension of the sign [21]. The greater the complexity of the sign the longer the time required for comprehension [27]. It also appears that proximity to hazards helps in the comprehension of the sign [27]

Visibility in the surrounding environment

The greater the visibility, the more likely a person is to recognise that a sign is present. This applies especially to locations at which other signs are present. The higher the visibility the quicker the recognition time [20]. Confusion can arise where there are multiple signs or multiple messages present as this has been shown to reduce the effectiveness of signs (through sign pollution) [23]. Advertising signage in particular competes with other signs. It often clutters the landscape, is placed in areas of high visibility and is visually attractive, thus drawing attention away from safety signs [23]. There is some evidence, although it is not strong, to say that people find it difficult to comprehend the meaning of multiple signs when grouped together [33].While inconclusive and based on the size of the sign, there is a maximum distance that a sign can be located from where the person is anticipated to be reading the sign, at which point the sign can no longer be understood [22].

Personal attributes of the person viewing the sign

A range of personal factors can affect an individual's recognition of signs, including legibility and comprehension. These include: poor eyesight (ability to see the sign) [20 29], fitness of person, head or neck mobility, age [29], language skills different from the sign [20 31], undertaking other tasks (such as talking on the phone or in conversation) [29], time of day (post lunch people tend to have a dip in performance [27]), and cognitive state [23 29 30].

Context

Context is also important for the recognition of a sign, as in one location the sign may have one meaning while in another location, a different meaning. For example, in the work place a sign with a goggles

symbol means 'wear safety glasses'; however in a shopping centre it may be interpreted to mean 'buy glasses here'. This does, however, vary by the type of sign. In one study [21], it was found that symbols with less context (e.g. a glove, boot or glasses alone) were harder to understand without being contextualised by the location in which the item is to be used; whereas a sign that includes symbols such as a pharmaceutical bottle, a car repair shop, or fishing area were more easily understood without contextual information. Considering this, signs that are site specific for water safety (e.g. shallow water, deep water, etc) and not applicable to whole locations may need to be placed close to the specific areas to which they apply.

Understanding signage

Issues related to understanding signage involve determining the process by which people come to comprehend signage. Do they automatically understand what they are reading? What measures can be utilised to improve a person's understanding of water safety signage and thus increase its effectiveness for influencing behaviour?

Persons that read and recognise safety signage must be able to understand the message that the sign is imparting for it to influence behaviour in a manner consistent with its purpose. For example, if a 'Shallow Water' sign is displayed, do people understand the meaning of the sign? That is, are they aware of the adverse outcomes (such as serious head injuries, spinal injuries or death) that may result from undertaking unsafe behaviour in shallow water? Do people understand the types of behaviours that should be undertaken when engaging with shallow water, such as checking the depth before entering and refraining from diving?

Impact of signage on behaviour

Another key issue associated with water safety signage is the impact it has on a person's behaviour. Little evidence exists as to the impact water safety signage has on people's behaviour and engagement with bodies of water and aquatic environments. Is water safety signage alone capable of creating measurable change in behaviour? For example, does the provision of regulatory signage, such as a 'No Diving' sign, mean that most people will refrain from engaging in diving at a particular location or within a specific body of water? Or does signage need to be accompanied by enforcement measures to achieve compliance?

Research yielded very little literature on the role of water safety signage and behaviour modification. Many people, whilst understanding a water safety sign and its meaning, may undertake risky behaviour and not be injured. These people attribute their safety to their own skills and believe they can ignore the signs as they 'know better' [34]. One study into road traffic signs noted that drivers were not complying with signage [26], yet it was not clear why this was the case. It is possible that where signage exists and a person has undertaken behaviour contrary to the advice of the sign with no detrimental outcome, in the future when that person observes the same warning sign, they may ignore the warning. This may be because they attribute their previous success of avoiding injury to their skills and believe that the sign does not apply to them [34].

This assumption is supported by the findings of a study conducted by Goldhaber and deTurck to examine the effectiveness of 'No Diving' signs at a school pool [35]. The study found that swimmers who have dived into shallow water in the past without injury feel more certain and confident that they know

how to dive into shallow water without hurting themselves. Consequently, 'No Diving' signs did not affect either students' perceptions of diving into shallow water as dangerous, or their intention to dive into shallow water. A 'No Diving' sign, the authors noted, "…is only one element of information affecting swimmer's decisions to dive into shallow water…"(pg 296) [35].

An expert witness called for the Uzabeaga v Town of Cottesloe case (discussed in further detail in the legal case study that follows this section), also expressed the view that there are many factors which determine the impact a sign will have. Even if a warning is understood, for example, "…it may not be complied with if it does not fit with people's attitudes and values…"(pg 15) [36].

Construction of signage - placement, size and height

The location in which the sign is placed has been found to be important with respect to the effectiveness of road signage [37], as placement affects people's ability to comprehend and understand signage [21 37]. In road safety signage, the consistent placement of signs in particular locations has been found to aid people in locating the sign [30]. It is yet to be determined, however, whether sighting the sign on a regular basis improves understanding and therefore influences behaviour effectively, or if such regular exposure becomes overexposure and instead leads people to ignore signage.

There is also some information from the area of road signage which indicates that the longer the duration of time between seeing the sign and seeing the hazard, the less likely people are to remember a sign's message [30], as recall of signage has been found to diminish quickly [24 34]. If a sign is placed away from a hazard, its meaning is less likely to be communicated effectively [24]. This, however, does not necessarily hold true for water safety signs, where people have the opportunity to study signs for a longer period and may already be familiar with the information prior to arriving at the aquatic environment, including any potential consequences. Water safety signs are predominantly placed at the access point to the aquatic environment, however it is unknown if people read these signs or if this is the best location for signs to be placed.

Research in road safety found that signage needs to be at a height that ensures the maximum number of users can read it [20 23 24]. The size of the sign and the information included on it needs to be proportional to the distance from which it will be viewed [24]. That is, if a sign is intended to be viewed from a distance or at high speed (if it is located along a road where the intended readers will be driving for example) the sign needs to be of adequate size, with legible symbols and words if relevant [20 23 24].

Case Study: Uzabeaga v Town of Cottesloe [2002]

This case study highlights the real life relevance of several of the key issues identified thus far. It also demonstrates the importance of integrating signage into a broader risk management strategy.

Background

On 1 March 1993, Luis Alberto Uzabeaga suffered complete tetraplegia after diving from the groyne at Cottesloe Beach. The groyne consisted of a "…pile of large rocks set on the sandy seabed…"(pg 4) [36]. Case notes also state that a concrete pathway had been built on the groyne to enable easy access, thus encouraging public use [36]. Uzabeaga sought damages from the defendant (the town of Cottesloe) for his injuries.

The defendant had posted signs prohibiting diving from the groyne and enlisted beach inspectors to patrol the beach. However the plaintiff (Uzabeaga) argued that both signage and supervision were inadequate, contending that a number of young people continued to dive off the groyne, despite prohibition [36]. This trial concerned the issue of the defendant's liability for the plaintiff's injuries.

At the time of the accident two signs were in place prohibiting diving on and near the groyne [36]. The signs contained the words 'Diving Prohibited' in large black letters below a red circle enclosing a graphic depiction of a diver crossed with a red line. This sign was compliant with sign 213 of AS2416 – 2002 [2]. The signs were placed on two light poles and it was necessary to walk directly past the signs to reach the dive rock when approaching along the groyne, as the plaintiff did on this occasion and all other occasions when visiting the beach [36].

Outcome

The defendant was found to have breached its duty of care by failing to erect signs warning of the dangers of diving from the groyne. However, the court ruled that this breach of the defendant's duty of care did not cause or contribute to the plaintiff's injuries. If liability had been established in this case, the plaintiff would have been found guilty of contributory negligence by his actions in exposing himself to risk of serious injury [36].

Issues raised by this case

A number of issues raised by this case are associated with the use and effectiveness of signage. These include enforcement, placement and visibility of signage, and the influence of personal values and past experiences on compliance. Importantly, these factors demonstrate that a best practice approach to water safety acknowledges that signage alone is not always effective in influencing behaviour and preventing injury.

Enforcement

In this case study the signage ('Diving Prohibited') was in place but ignored. Prohibition signage is unlikely to be effective unless it is enforced by regular patrols, fines or some other form of punishment.

If enforcement cannot be provided, there may be value in using advisory signage which warns of the hazards and potential risks. This signage provides visitors with information which they may use to inform their behaviours. Further research on this issue is required to determine the role of enforcement on water safety signage.

Personal values and past experiences

Expert witnesses and additional information referred to within the case notes make reference to the role of past experiences on compliance with signage. One such witness was Professor Laurence Hartley, a professor of psychology at Murdoch University. The case makes reference to a report written by Professor Hartley which was tendered as evidence. This report notes that there are "…many factors which determine what impact a sign will have…"(pg 15) [36].

Hartley states that even if a person understands a warning they may not comply with it if it does not fit with that person's attitudes and values [36]. This was noted with respect to the plaintiff's perception of risk. If one does not perceive there to be a risk, it is unlikely that person will act in a manner to negate that risk. For example, the plaintiff did not perceive there to be a risk when diving off the groyne. He

continued to dive off the groyne and did not alter his behaviour despite the existence of signage warning of the risks.

A study into the effectiveness of 'No Diving' signs by Goldhaber and deTurck was also tendered as evidence in this case. This study involved highly conspicuous 'No Diving' signs being placed at the shallow end of a middle school diving pool for a period of four weeks and testing the impact the signage had on the student's behaviour.

This study exposed people to signage for a month; a period of exposure longer than normal for warning signs. The authors believe it was doubtful that students would not have seen the sign, as they all attended the pool during the period. However, the authors postulate that the students may not have consciously processed the information presented in the 'No Diving' signage [36].

Although it is possible for information not processed at a conscious level to exert considerable influence on memory and judgements, the authors found that the 'No Diving' signs did not affect students' perceptions of diving into shallow water as dangerous, or their intention to dive into shallow water [36].

Similarly, it determined that past behaviour has an impact upon the effectiveness of signage which prohibits diving. It was found that if a swimmer had dived into shallow water in the past without sustaining any injuries, that swimmer will feel more confident that they know how to dive into shallow water without hurting themselves [35].

This indicates that positive experiences from past experiences may negate the impact of prohibitive signage for influencing behaviour and preventing injury.

Risk management principles

The outcomes of the Uzabeaga v Cottesloe case highlight the importance of utilising water safety signage as one element within broader risk management practice.

By applying the hierarchy of control approach to reduce risk in a case such as this, the risk posed by the hazard (the groyne) could have been managed by firstly attempting to remove the groyne; substituting it for another, providing a safer place to dive at the beach; or isolating the hazard by fencing off or blocking the path to the groyne. Water safety signage (a behavioural control) is employed if a minimisation of risk cannot be achieved by creating safer environments via the above means. A best practice approach to water safety and injury prevention does not rely upon water safety signage in isolation, as discussed in the following section.

Best practice approach to water safety signage

Given the lack of research which considers water safety signage specifically, it is difficult to provide definitive advice regarding the effective use of signs to promote water safety and prevent aquatic related injuries. It is therefore recommended that a risk management approach, incorporating a risk assessment, be utilised in public aquatic environments such as pools, beaches, lakes, and foreshores. This process involves identifying hazards and risks, analysing and evaluating the risks associated with the hazards and then using the hierarchy of control principles to eliminate or control the hazards and associated risks. Signage can then be considered as a control measure when applying the hierarchy of control.

Risk Management in Water Safety

The Guidelines for Safe Pool Operation (GSPO) define risk management as "…the process of identifying, assessing and controlling risks to people, to an organisation, or to an asset…" (APP 4) [38]. What this means is that an operator should consider the hazards and risks associated with a particular location or activity and then work towards removing them.

Where it is not possible to remove the hazards and/or risks, measures should be implemented to reduce/control the risks. A risk management approach should be taken for all decisions and activities concerning bodies of water, to ensure that water safety is maintained. An employer or person in control of a workplace (including aquatic locations) has a legal obligation to minimise risks to health and safety arising from the workplace to the extent that it is reasonably practicable to do so [39]. This approach should also include the establishment of an appropriate infrastructure and culture within an organisation or at a location (Figure 2).

Figure 2: Risk Management Process Flow Chart

Identification of Hazards and Risks

The identification of hazards and risks is one of the key issues for land managers and venue operators with respect to the provision of water safety signage. Different bodies of water each have inherent hazards and risks.

A hazard is defined as a source of potential harm [40], that is, any factor that could cause harm or injury. Examples of hazards that may be present at aquatic environments include: large swells, rips and strong currents at beaches; submerged hazards such as pumps, murky water and steep banks for dams; and changing conditions, cold water and motor boats for lakes and lagoons.

The Northern Territory Occupational Health and Safety Regulations define risk as "…the probability that a hazard's potential to cause injury or compromise the health and safety of a person or to cause damage to a plant or premises may become actual …" (pg 8) [41]. Risks in aquatics may include the likelihood of a

hazard causing death, injury (such as brain damage from prolonged submersion or spinal injuries and paralysis) or illness (such as Legionnaire's disease and Cryptosporidiosis).

Analysing and evaluating risks associated with hazards

Once the hazard(s) has been identified, an assessment of the risks associated with the hazard(s) can be undertaken. Consequence and likelihood tables, such as those used in the case study example in the next section of this report, can assist with this process.

Hierarchy of Control

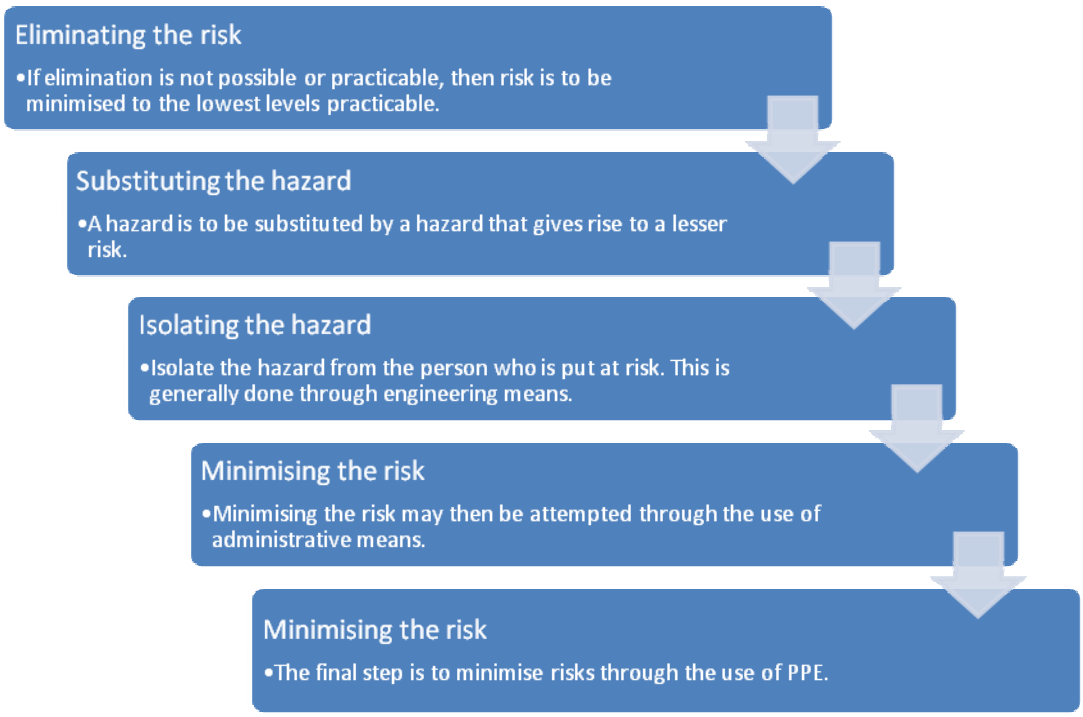
Employers, including local governments and public pool managers have a legal duty to minimise or control risks to health and safety to the extent that it is reasonably practicable. In many instances they also have a legal obligation under duty of care principles to address hazards and risks in environments under their control. Local governments and other managers of public aquatic venues must ensure that they fulfil their legal obligations in order to minimise the likelihood of prosecutions for failure to comply with occupational health and safety legislation or litigation based on breaches of duty of care (negligence).

Best practice risk management employs the hierarchy of control approach, focused on making the environment safe, as opposed to relying on behavioural controls.

The hierarchy of control involves:

1. Eliminating the risk
2. Substituting the hazard
3. Isolating the hazard
4. Minimising the risk through administrative controls
5. Minimising the risk through the use of personal protective equipment (PPE) (Figure 3).

Figure 3: Hierarchy of Control



Using signage as an administrative control measure

Signage is classified as an administrative control measure and is therefore ranked low on the hierarchy of control. Where possible and practicable it is therefore preferable to use other control measures that are ranked higher on the hierarchy of control. For example, it is preferable to fence off a dangerous cliff to prevent falls in to water, rather than simply use signage to warn people of this danger. However, in some instances, it is not feasible to eliminate, substitute or isolate hazards and risks and administrative controls may need to be applied. This is where signage can be valuable.

If a decision is made to use signage as an administrative control measure, the next step is to determine the type of sign to be used. There are currently three documents in Australia that provide a list of water safety signs, and these may be useful reference guides:

- Australian Standard AS2416: Design and Application of Water Safety Signs [2]
- Best Practice Manual: Signs as Remote Supervision [15]
- National Aquatic and Recreational Signage Style Manual [3]

It is recommended that the Australian Standard be used as the primary document when selecting a water safety sign. The Australian Standard provides a clear rationale as to the process by which signs are included in the Standards, however this is not the case for the other two documents.

The 'Best Practice Manual: Signs as Remote Supervision' by Statewide Mutual [15], provides an approach for determining the appropriate sign as well as guidance relating to placement of signs.

The National Aquatic and Recreational Signage Style Manual [3] is intended to be a guide for land managers/owners that provides guidance on the best practice use of signs in an aquatic environment. A range of factors also need to be considered including placement, size, height, legibility of the sign and proximity to the hazard. Other strategies, such as enforcement and compliance measures may also be required to ensure the signage acts as an effective control. Public awareness and education strategies may also be used to increase understanding of messages conveyed on signage.

Case Study: The provision of signage at a hypothetical public pool

This example is intended to illustrate the process of identifying, analysing and evaluating hazards and risks in public aquatic environments. It also demonstrates how a risk management approach might utilise signage as a measure to control hazards and associated risks. Each aquatic environment is different and each will require its own risk assessment and control measures to eliminate or reduce hazards and risks.

The provision of signage at public pools represents both a means of maintaining water safety and is an important facet of a risk management plan. Signage recommendations have been referenced, where possible, to the relevant Australian Standard or the Guidelines for Safe Pool Operation.

Establish the context

A hypothetical 50m public swimming pool in Australia with a water depth which varies from 1.2m at the shallow end to 2m at the deep end.

Identification of hazards

The first step is to identify all hazards and consider possible adverse outcomes associated with those hazards:

Table 1 Hazards at public pools

Hazards (factors that could cause injury)	Possible adverse health and safety outcomes
Variable water depths	Drowning, especially for those not confident in the water who find themselves in deep water. Variable water depths may also expose people to minor injuries from slipping on the base of the pool.
Shallow water	Risk of injury from diving into shallow water ranging from minor (abrasions, bruising) to significant (head and spinal injuries) and death due to drowning.
Deep water	Risk of significant injury such as brain damage due to prolonged submersion and death due to drowning.
Water on the pool deck	Falls resulting in death or injury ranging from minor (bruising and abrasions) to significant (head and spinal injuries).
Evacuation of large numbers of people in an emergency	Risk of injury ranging from minor (abrasions and bruising) to significant (broken bones) and death due to crushing or suffocation.

Analysing and evaluating risks associated with hazards

Once the hazard(s) has been identified, an assessment of the risks associated with the hazard(s) can be undertaken using probability and consequence tables. Table 2 provides a scale for determining the probability or likelihood of a hazard resulting in various adverse outcomes. Table 3 provides a scale for determining the consequence of a hazard resulting in various adverse outcomes.

Table 2 Probability table

Category	Probability/Description
A	Almost certain, common – is expected to occur in most circumstances
B	Likely, has happened – will probably occur in most circumstances
C	Possible, could happen – might occur at some time
D	Unlikely, not likely – could occur at some time
E	Rare, practically impossible – may occur only in exceptional circumstances

Table 3 Consequence assessment table

Category	Consequence (Harm)/Description
1	Catastrophic – fatalities
2	Major – serious injury, such as permanent disability
3	Moderate – medical treatment or lost time injury
4	Minor – minor injury, such as first aid
5	Insignificant – no injury

The probability and consequence scales are then used to determine a risk score (Table 4) that indicates whether the hazard and associated risks are high, medium or low (Table 5). The risk scores can then guide decisions on which hazards require control measures to be implemented and which should be treated as high priorities (Table 6).

Table 4 Probability assessment table

Probability						
A	**B**	**C**	**D**	**E**		**Consequence**
1	2	4	7	11	**1**	
3	5	8	12	16	**2**	
6	9	13	17	20	**3**	
10	14	18	21	23	**4**	
15	19	22	24	25	**5**	

Table 5 Risk score table

Risk Score	Interpretation
1-6	High risk: immediate correction required, consider discontinuing
7-15	Medium risk: attention needed, correction required
16-25	Low risk: perhaps acceptable as is

Table 6 Example risk assessment table based upon the public pool

Hazard and outcome severity		Consequence	Likelihood	Risk score
Variable water depths	No injury	5	A	15
	Minor injury	4	B	14
	Moderate injury	3	D	17
	Major injury	2	D	12
	Fatal injury	1	E	11
Shallow water	No injury	5	B	19
	Minor injury	4	D	21
	Moderate injury	3	D	17
	Major injury	2	D	12
	Fatal injury	1	D	7
Deep water	No injury	5	A	15
	Minor injury	4	C	18
	Moderate injury	3	D	17
	Major injury	2	E	16
	Fatal injury	1	E	11
Water on the pool deck	No injury	5	A	15
	Minor injury	4	C	18
	Moderate injury	3	D	17
	Major injury	2	D	12
	Fatal injury	1	E	11
Evacuation of large numbers of people in an emergency	No injury	5	A	15
	Minor injury	4	B	14
	Moderate injury	3	B	9
	Major injury	2	D	12
	Fatal injury	1	E	11

In addition to using risk scores to decide whether hazards and risks require control measures, factors such as the number and type of people exposed to the hazards and risks should be considered. A hazard without a high risk score may still warrant priority attention. For example, if large numbers of people are sustaining minor injuries from water on the pool deck, implementing control measures might be regarded as a high priority, even if the risk score does not rank it as a high risk.

Eliminate or control the hazards and associated risks

Signage can be considered, within the hierarchy of control approach, as a control measure to minimise risk associated with hazards. Table 7 provides some examples of how signage could be used to minimise some risks associated with common hazards at public pools.

Table 7 Hazards and recommended signage control measures

Hazard	Use of signage as an administrative control measure
Variable water depths	*Place depth markers where they can be seen from both in and out of the pool. GSPO (FD3) [38]
Shallow water	*Place depth markers, No Diving Signs and/or Shallow Water Signs in, next to the pool or even prior to entering the pool. GSPO (FD3) [38], AS2416 (Sign 213 – No Diving), AS2416 (Sign 228 – Shallow Water) [2]
Deep water	*Place depth markers and deep water signage. GSPO (FD3) [38], AS2416 (Sign 216 – Deep Water) [2].
Water on the pool deck	*Place slippery area signage from AS2416. May also utilise No Running signage or signs with pool rules on them. AS2416 (Sign 235) [2]
Evacuation of large numbers of people in an emergency	*Utilise exit signage to identify emergency exit points AS2293.3 [42]

Risk assessment is an important means of ensuring that signage is being utilised effectively. By undertaking a risk assessment of an aquatic environment a manager/owner can determine whether signage is an appropriate control measure. It can also help ensure that signage is in an effective location, such as a main access point and/or before the visitor encounters the hazard and that the signage is legible and being adequately maintained.

It should be noted that the use of signage forms one part of risk management approach to water safety. Ideally, site specific information should be obtained to inform this process. Without empirical data, it is hard for the operator to know how effective these approaches will be in managing risks to health and safety.

Discussion

Understanding each of the factors discussed thus far is vital to improving the effectiveness of water safety signage for the promotion of water safety and the prevention of aquatic related injury, including drowning, in Australia.

Surveys have shown that the Australian population uses a diverse range of aquatic environments to undertake a variety of activities [43], and research by the Royal Life Saving Society Australia has identified that drowning occurs in a wide range of aquatic bodies [44]. As the majority of drowning deaths are preventable, the provision of water safety signage across each of these bodies is an important safety measure that can be undertaken in an attempt to reduce drowning figures.

Regulation, consistency and understanding of signage

A single and consistent system of signage is required to ensure that symbols and safety signage have the same meaning all over the world. A symbol with universal meaning can negate issues of comprehension among people with varying language and cultural backgrounds.

Consistency increases the likelihood of signage being recognised and understood, particularly by people visiting a new location. The consistency of signage can be achieved through regulation. Standards Australia and the International Standards Organisation provide a regulatory framework for safety signage. While both Australian Standards and International Standards are updated regularly, strong communication between these organisations is necessary to ensure that AS reflect those standards recognised internationally.

Many of the issues identified thus far that affect recognition and understanding of signage (particularly design issues such as size, luminosity and clarity) have already been addressed by Australian Standards. Signs included in the AS should therefore be used where possible.

Ideally, Australian Standards would be used as the overarching document related to water safety signage in Australia, with all signs used in water safety included. This would incorporate all signs included in existing documents - the 'National Aquatic and Recreational Signage Style Manual', for example, which provides a list of additional signs. Each of the signs in this document should be tested for comprehension and included in AS2416, subject to passing test requirements. The use of one, overarching document such as this should reduce the number of signs in use and subsequently improve signage comprehension.

There is some ambiguity regarding the Australian Standards process. In particular, it is unclear how decisions are made in the selection of signs for testing and inclusion within the Australian Standard. Furthermore, there appears to be no published material available related to previous testing (i.e. how and when tests were conducted, who participated and results produced). There is also no information publicly available which documents whether a person's comprehension of signage changes over time. Where possible, the results of comprehension tests should be published in a peer reviewed publication or, at the very least, be made available to the public.

In other areas, further research is required to inform policy decisions and establish a more comprehensive evidence base for the use of water safety signs. For example, it is unknown whether

certain styles of signage, such as discreet signage (that is signage that is designed to blend in with the surrounding environment, often used in National Parks), is less easily recognised, or whether such signage is less effective. The use of signage should be used as part of a careful and considered risk management process.

Impact on behaviour

Further research is required to definitively identify any links between water safety signage and behaviour. This research should take into consideration the impact of previous exposure to hazards, personal values and past experiences on risk taking behaviour. Evidence indicated that past experiences and personal values affect the manner in which people engage with signage. The Uzabeaga v Town of Cottesloe case study (p14) demonstrates how signage is often ignored due to positive past experience (enacting behaviour in the past without negative consequences), and inconsistencies between the purpose of signage and personal values and attitudes [36]. A better understanding of the influence of past experiences and personal values on behaviour is needed to improve compliance with signage.

A study into advance warning and advisory signage at railway crossings in Canada found that signage can positively influence behaviours [37]. Thus, if this applies to aquatic environments also, signage can be used to promote water safe behaviours and prevent drowning. Signs should provide instruction on suitable and safe behaviours specific to the aquatic environment being accessed.

Information relating to the impact of road safety signage on behaviour may not necessarily apply to the aquatic environment. This is due to the different environments and circumstances in which signs are encountered. Usually, road safety signs are seen immediately prior to where action is required; they are often viewed from a distance, at high speed, and there may be limited viewing time. People are frequently exposed to road signs and this may increase recognition, understanding and impact on behaviour. Most people also receive road safety training as part of learning to drive and have been exposed to road safety campaigns. Furthermore, they are aware of the risk of detection and consequences such as fines or loss of driving license, and this may influence behaviour.

In contrast, water safety signs are often situated away from the hazard, the person is often walking past the sign and can if necessary, stop and review the information, as well as walk up close to the sign. People receive little water safety training and almost none on signage. In addition, water safety signs are not as commonly or consistently used as road signs. Each of these issues may influence factors such as recognition, understanding and impact on behaviour when water safety signs are encountered.

Placement, Size and Height of Signage

In the area of road safety, the closer a safety sign is to the hazard the higher the probability that a person will act upon the information contained [24]. Whilst the placement of signage influences the effectiveness of road safety signs, no information is available to determine whether this also applies to water safety signs.

One approach may be to place signage at access points to an aquatic environment, alerting users to the potential hazards and risks they may encounter prior to entering the area. However, this option may also be difficult and expensive, particularly in aquatic environments that can be entered from a number of different points.

In many instances, information unrelated to safety is displayed at access points to aquatic environments. This adds to the amount of signage placed in any one spot and may reduce recognition and the effectiveness of water safety signs, as multiple signs in one location can hinder people's understanding and recollection of key messages [45], as well as their ability to discern which information is most important. Separating safety signs from other signage, such as advertising, may address some of these issues and improve the effectiveness of signage as a safety measure; however this premise also remains to be tested.

There are also issues associated with the location of signage at places such as swimming pools and National Parks, where visitors are often required to pay an entry fee in order to use the facilities. The payment of money establishes a formal contract between the payee and the facility. Upon payment the payee is agreeing to the conditions of entry and should be made aware of these conditions prior to the exchange of money. This factor should be a consideration when placing signage at a particular aquatic facility or location. Signage should detail the hazards and risks a visitor may be exposed to within the facility or location and should be placed at all entry points.

Enforcement and compliance

The issue of enforcement of water safety signage is complex. It involves managers/owners of aquatic environments using water safety signage appropriately (i.e. within a broader risk management approach) to ensure the health and safety of those within their care. Related to this is the need to ensure that signage is effective and adequately maintained.

Other issues that need to be examined associated with enforcement and compliance, include: How effective is warning signage in preventing people from accessing an unsafe area or engaging in an unsafe behaviour? Is the provision of regulatory signage alone effective in preventing an activity from being undertaken? Or does enforcement in the form of lifeguard supervision or penalty for non-compliance need to be provided as added incentive for a person to comply with signage?

Understanding the way in which people engage with water safety signage will assist with enforcement. If we can understand the aspects of signage that motivate people to comply, this information will assist in creating more effective signage.

Little is currently known about enforcement of water safety signs. Enforcement has been used for many years to ensure compliance with traffic signs; however this is often part of a wider safety campaign and the effect of signs alone on compliance is still unclear [26]. Compliance has been found to be related to concerns about being 'caught doing the wrong thing' and subsequent punishment [46]. The reduction in alcohol related road accidents has been strongly linked to the perceived risk of offenders being apprehended, and the understanding that following apprehension, penalties are inevitable and severe [46].

There is a need to strengthen the evidence base surrounding water safety signage to inform the development of strategies to improve compliance. Such research should also examine people's engagement with water safety signage and the effect, if any, that additional measures such as the use of punishment or patrols by lifeguards and other authority figures have on compliance. A better

understanding of how perceptions of the consequences of non-compliance may influence adherence to signage is essential for more effective water safety signage.

Best practice approach

A risk management approach to water safety is essential for identifying and effectively controlling hazards and risks in aquatic environments. The application of the hierarchy of controls also aims to ensure that the most effective control measures are used to minimise risk. Best practice takes into consideration the wider effects of any control measure that is employed; for example the environmental impact of barriers constructed in order to isolate a risk.

Water safety practice will be enhanced significantly by an improved information base which elucidates how, why and how often people are being injured at aquatic environments. Such data is extremely useful when identifying, analysing and evaluating hazards and risks, as well as in the subsequent development of injury prevention strategies.

Owners/managers of aquatic locations need to ensure a balance between signposting all foreseeable hazards and limiting the counteractive effects of the overabundance of signage. By signposting only the most dangerous hazards or severe risks that a visitor may face (based on the outcomes of a risk assessment), a manager of the environment in question can reduce the likelihood of injury, whilst at the same time avoid sign pollution, thus increasing the potential of a person to recognise and understand the sign.

The outcomes of recent legal action reflect the validity of this approach, determining that a council's duty of care does not extend to erecting warning signs to identify every hazard within their jurisdiction. Judgements in Vairy v Wyong Shire Council and Mulligan v Coffs Harbour City Council held that councils do not have to signpost all hazards and that some responsibility must be taken by people to reduce risks to their own health and safety [47] [48].

The value of signage

The application of a best practice approach to water safety signage is important so that signs are used to better ensure the safety of those using aquatic environments. Whilst signs are passive in terms of safety and offer no protection [37], signage is of value because it can alert people to hazards and/or risks that otherwise may or may not be easily identified . Signage is one measure that can be used, either in isolation or in conjunction with other control measures, to minimise risk and prevent injury.

AS2342 also makes the point that provided signage is well designed and self-evident, "…it can transcend language barriers…" (pg 4) [17]. This is particularly beneficial in a multicultural and tourism focused country such as Australia.

Recommendations for Future Direction

Based on research undertaken in the course of preparing this issues paper, the authors offer the following recommendations and discussion points for future direction in the following four areas of water safety signage:

Improving the evidence base

- There is a need to improve our understanding of those factors that impact on a person's behaviour following exposure to water safety signage. Specifically:
    - **Compliance:** Do factors such as personal values and past experiences impact upon the likelihood of a person following a sign's advice?
    - **Comprehension:** Do people understand a sign's meaning and does this impact upon behaviour change?
    - **Placement** – Does proximity to the hazard increase recognition of signage and thus effectiveness?
    - **Construction:** What role do factors such as size, design, luminosity, visibility play in improving comprehension of signage?
    - **Maintenance:** Are well maintained signs more likely to be recognised and thus complied with?
    - **Enforcement:** Is signage alone effective or do enforcement measures such as fines or patrols increase the likelihood of compliance?

Management of aquatic locations

- A risk management approach that follows the hierarchy of control principles should be used to inform decisions regarding the use of water safety signage when there is a need to warn the public of a hazard and/or risk.
- Systems should be implemented to record and analyse information on injuries and incidents which occur at aquatic environments.

Public awareness

- Public education campaign(s) should be undertaken to promote awareness and understanding of water safety signs and compliance with such signage.

Australian Standards (regulatory framework)

- Australian Standard 2416 should include all water safety signs required in Australia.
- Australian Standards for water safety signs should be consistent with International Standards. Consistency of Australian and International standards will help improve comprehension of and compliance with water safety signage by overseas visitors.

Conclusion

Whilst there is very little evidence regarding the effectiveness of water safety signage, there are a number of principles taken from the road safety signage evidence base that have been, or should be, considered for water safety signs. In the absence of information that is specific to water safety, these findings can be used to guide policy decisions relating to water safety signage. It is recommended that a risk management approach be adopted to identify hazards and risks that might require control measures. The hierarchy of controls should be applied to select appropriate measures for minimising risk in aquatic locations, and signage should be considered within this context.

A strengthened evidence base on the use of water safety signs and their influence on behaviour is necessary to improve the effectiveness of signage as a strategy to promote water safety and prevent drowning. Some of the most pressing areas that require research relate to the impact and effectiveness of signage; i.e. location of signs, factors affecting the influence of signage on behaviour, sign pollution, and enforcement and compliance issues. Information on how people use and interact with different aquatic environments would also be useful. Available evidence indicates that signage alone is not always effective and it is therefore essential that other strategies and methods, such as public education and awareness raising campaigns and broader risk management strategies, be used to complement signage.

Recommendations for future direction have been based on the literature reviewed for this report and are intended to improve the effectiveness of signage in promoting water safety and preventing aquatic related injuries, including drowning, in all public aquatic environments. This is an important public health issue and establishing an evidence-based approach to the use of signage should be a high priority for water safety.

Contributors

All information in this report reflects the views of the authors and as such any mistakes and conclusions are those of the authors. The authors would like to thank Austin Adams, Rob Barnes and Brett Ellis for providing insights into signage in Australia which helped in the creation of this issues paper. It is hoped that this issues paper provides a direction for the improvement of water safety signage in Australia.

Acknowledgements

Funding for this report was provided by the Australian Government Department of Health and Ageing.

Suggested Citation

Franklin RC, Peden A, Rubin T, Scarr J (2008) Issues Paper. Using signage to promote water safety and prevent aquatic related injuries in Australia: An examination of the key issues. Australian Water Safety Council: Sydney [Secretariat: Royal Life Saving Society Australia, PO Box 558, Broadway NSW 2007, Australia].

Glossary

AS	Australian Standards; documents presenting highly technical information on specific topics
AS1319	Safety Signs for the Occupational Environment
AS2342	Development, testing and implementation of information and safety symbols and symbolic signs
AS2416	Design and Application of Water Safety Signs
AS/NZS4360	Risk Management
AWSC	Australian Water Safety Council
Bodies of water	Bodies of water include seaside (beaches), rivers, creeks, dams and open drains [2]. This definition has been extended to include swimming pools and aquatic facilities
CALD	Culturally and Linguistically Diverse
Composite sign	A composite sign is a sign that carries more than one symbol on a signboard, or a sign which comprises any combination of symbols, words and arrows on the one signboard [17]
Discreet signage	Unobtrusive signage, signage that blends with its surroundings such as the style of signage that may be employed in national parks
Groyne	Timber framework or low broad wall run out to check drifting of beach and so stop encroachment of sea[49]
GSPO	Guidelines for Safe Pool Operation
Hybrid sign	A hybrid sign is a sign where the meaning of the symbol is repeated in words [4]
IS	International Standards
ISO	International Standards Organisation
Legibility	The extent to which the details of a symbol are sufficiently discernable to enable the meaning of the symbol to be determined [17]
Legibility distance	Factors that affect the distance at which a symbol needs to be legible and who the intended and potential users are [17]
NESB	Non English Speaking Background
NWSP	National Water Safety Plan

OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
Prohibition sign	A prohibition sign, under the Australian Standards system, must be made up of a symbolic shape comprising the red annulus and slash symbol with plain white interior [4]
Recreational activity	(a) any sport (whether or not the sport is an organised activity), and (b) any pursuit or activity engaged in for enjoyment, relaxation or leisure, and (c) any pursuit or activity engaged in at a place (such as a beach, park or other public open space) where people ordinarily engage in sport or in any pursuit or activity for enjoyment, relaxation or leisure [50]
Risk	The likelihood that a hazard's potential to cause injury or compromise the health and safety of a person or to cause damage to a plant or premises may become actual [41]
Risk management	Involves establishing an appropriate infrastructure and culture and applying a logical and systematic method of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process in a way that will enable organisations to minimise losses and maximise gains [40]
RLSSA	Royal Life Saving Society Australia
SA	Standards Australia
Sign	An inscribed board, plaque or other delineated space on which text or symbols or both are used to convey a message [17]
Sign pollution	This is where there are signs concentrated in large numbers or in one place making it difficult to recognise important or relevant signs
SLSA	Surf Life Saving Australia
Symbol	A graphic or pictorial device used to represent objects or concepts and can include letters, numerals and punctuation marks [17]
Symbolic sign	A sign comprising the combination of a graphic symbol, a symbolic shape and a colour code, which may either stand alone, or may form an element of a composite sign containing text, other symbols, symbolic signs or a combination of these [17]
Warning sign	Warning signs are signs with a black border on a yellow background. These signs advise of a particular hazard or hazardous condition, or that an activity is not recommended [1]

References

1. Royal Life Saving Society Australia. Water Safety Signs: A Translated Guide. Broadway, 2005.
2. Standards Association of Australia. Australian Standard 2416: Design and Application of Water Safety Signs. In: Standards Australia, editor: SAI Global, 2002.
3. Ellis B, Waters W, Life Saving Victoria. National Aquatic and Recreational Signage Style Manual Third edition, 2006.
4. Standards Association of Australia. Australian Standard 1319: Safety Signs for the Occupational Environment: Standards Australia, 1994.
5. Tawfiq M. Abu-Ghazzeh. Signage and the law: Towards the introduction of a sign control system in Amman, Jordan. *Cities* 1996;13(4):257-263.
6. Government of New South Wales. Local Government Act 1993. *No. 30*: New South Wales Government, 1993.
7. Australian Water Safety Council. A Guide to Water Safety Essentials for Local Governments. Sydney, 2008.
8. Government of Australian Capital Territory. Australian Capital Territory (Self-Government) Act 1988: Australian Capital Territory Government, , 1988.
9. Government of Northern Territory. Local Government Act: Northern Territory Government, 2007.
10. Government of Queensland. Local Government Act 1993: Queensland Government, 1993.
11. Government of South Australia. Local Government Act 1999: South Australia Government, 1999.
12. Government of Tasmania. Local Government Act 1993: Tasmania Government, 1993.
13. Government of Victoria. Local Government Act 1989: Victoria Government, 1989.
14. Government of Western Australia. Local Government Act 1995: Western Australia Government, 1995.
15. Statewide Mutual. Signs as Remote Supervision: Best Practice Manual. Version 3, 2007.
16. Standards Australia. Development Phases: Standards Australia, 2007.
17. Standards Association of Australia. Australian Standard 2342: Development, testing and implementation of information and safety symbols and symbolic signs. In: Standards Australia, editor: SAI Global, 1992.
18. International Organization for Standardization. About ISO: International Organization for Standardization, 2007.
19. Kerr C, Taylor R, Heard G, editors. *Handbook of public health methods*. Sydney: McGraw-Hill, 1998.
20. Lambert LD, Fleury M. Age, Cognitive Style, and Traffic Signs. *Perceptual and Motor Skills* 1994;78(2):611-24.
21. Wolff JS, Wogalter MS. Comprehension of pictorial symbols: Effects of context and test method. *Human Factors* 1998;40(2):173-186.
22. Ells JG, Dewar RE. Rapid Comprehension of Verbal and Symbolic Traffic Sign Messages. *Human Factors* 1979;21(2):161-168.
23. Boersema T, Zwaga HJG. Searching for routing signs in public buildings: the distracting effect of advertisements. In: Brogan D, editor. *Visual Search*: Taylor & Francis, 1990:151-157.
24. Babbitt Kline TJ, Ghali LM, Kline DW, Brown S. Visibility distance of highway signs among, young, middle-aged, and older observers: Icons are better than text. *Human Factors* 1990;32(5):609-619.
25. McDougall SJP, Curry MB, De Bruijn O. Measuring symbol and icon characteristics: Norms for concreteness, complexity, meaningfulness, familiarity, and semantic distance for 239 symbols *Behaviour Research Methods, Instruments & Computers* 1999;31(3):487-519.
26. Al-Madani H. Prediction of drivers' recognition of posted signs in five Arab Countries. *Perceptual and Motor Skills* 2001;92(1):72-82.

27. McDougall S, Tyrer V, Folkard S. Searching for Signs, Symbols, and Icons: Effects of Time and Day, Visual Complexity, and Grouping *Journal of Experimental Psychology: Applied* 2006;12(2):118-128.
28. Ho G, Scialfa CT, Caird JK, Graw T. Visual Search for Traffic Signs: The Effects of Clutter, Luminance, and Aging. *Human Factors* 2001;43(2):194-207.
29. McPhee LC, Scialfa CT, Dennic WM, Ho G, Caird JK. Age Differences in Visual Search for Traffic Signs During a Simulated Conversation. *Human Factors* 2004;46(4):674-685.
30. Fisher J. Testing the Effect of Road Traffic Signs' Informational Value on Driver Behaviour. *Human Factors* 1992;34(2):231-237.
31. Ballantyne R, Carr N, Hughes K. Between the flags: An assessment of domestic and international University Students' knowledge of beach safety in Australia. *Tourism Management* 2005;26(4):617-622.
32. Charlton SG. Conspicuity, memorability, comprehension, and priming in road hazard warning signs. *Accident Analysis and Prevention* 2006;38:496-506.
33. Duncan J. Selective Attention and the Organization of Visual Information. *Journal of Experimental Psychology: General* 1984;113(4):501-517.
34. Henkel LA, Mather M. Memory attributions for choices: How beliefs shape our memories. *Journal of Memory and Language* 2006;57:163-176.
35. Goldhaber GM, deTurck MA. Effectiveness of Warning Signs: "Familiarity Effects". *Forensic Reports* 1988;1:281-301.
36. Uzabeaga v Town of Cottesloe: District Court of Western Australia, 2002.
37. Ward NJ, Wilde GJS. Field Observation of Advance Warning/Advisory Signage for Passive Railway Crossings with Restricted Lateral Sightline Visibility: An Experimental Investigation. *Accident Analysis and Prevention* 1995;27(2):185-197.
38. Royal Life Saving Society Australia. Guidelines for Safe Pool Operation (GSPO), 2006.
39. Walter R, Riddell P. High Court's Decisions on Obviously Risky Diving Cases, 2005.
40. Standards Association of Australia and New Zealand. Australia/New Zealand Standard 4360: Risk Management. In: Standards Australia and New Zealand, editor: SAI Global, 2004.
41. Government of Northern Territory. Work Health (Occupational Health and Safety) Regulations 2006: Northern Territory Government, 2006.
42. Standards Association of Australia. AS 2293.3 - 2005: Emergency escape lighting and exit signs for buildings Part 3: Emergency escape luminaries and exit signs: Standards Australia.
43. Franklin RC. Evaluation of Bronze. Sydney: Royal Life Saving Society Australia, 2006:67.
44. Royal Life Saving Society Australia. The National Drowning Report 2007: Royal Life Saving Society Australia, 2007.
45. Kaptein NA, Theeuwes J, van der Heijden AHC. Search for a conjunctively defined target can be selectively limited to a colour-defined subset of elements. *Journal of Experimental Psychology: Human Perception and Performance* 1995;21(5):1053-1069.
46. National Expert Advisory Committee on Alcohol. Alcohol in Australia: Issues and Strategies. Canberra, 2001.
47. Vairy v Wyong Shire Council [2005]: High Court of Australia, 2005.
48. Mulligan v Coffs Harbour City Council [2005]: High Court of Australia, 2005.
49. The Concise Oxford Dictionary. In: Sykes J, editor. *The Concise Oxford Dictionary*. 7th ed. Oxford: Oxford University Press, 1982.
50. Government of New South Wales. Civil Liability Act 2002. In: New South Wales Government, editor, 2002.
51. Surf Life Saving Australia. Australian Coastal Public Safety Guidelines. First edition ed, 2007.
52. Statewide Mutual. About Statewide: Statewide Mutual, 2007.
53. Peden A, Franklin R, Eccleston S. Position Paper. Public Swimming Pool Legislation in Australia: An examination of the legislation. Sydney: Australian Water Safety Council, 2007.

Resources

There are a number of resources available that include information on water safety signage. The following list in alphabetical order provides a summary of those resources available. The authors have made no assessment of their value.

A Guide to Water Safety Essentials for Local Governments

The 'Guide to Water Safety Essentials for Local Governments' has been produced by the Australian Water Safety Council (AWSC) to help those in local government gain a greater understanding of water safety. The Guide provides direction for taking a risk management approach to aquatic safety in local areas and is designed for people who interact with aquatics or wish to increase their knowledge on risk management and water safety issues.

The Guide takes a best practice approach and provides essential information and a valuable list of resources that readers can consult for further information. A wide range of aquatic environments are covered in this document:

- Beaches
- Dams
- Home Swimming Pools
- Lakes and Lagoons
- Open Drains and Irrigation Channels
- Public Swimming Pools
- Rivers and Creeks

The Guide to Water Safety Essentials for Local Governments also includes information on the provision of safety signage, relevant water safety qualifications and training for staff and operators, and legal duties of local governments.

Australian Coastal Public Safety Guidelines 1st Edition

The Australian Coastal Public Safety Guidelines 1st Edition has been created by Surf Life Saving Australia (SLSA) and have been developed following research both in Australia and internationally and through extensive industry consultation [51]. The guidelines cover such topics as the provision of safer coastal environments, general operations of beaches, lifesaving services, lifesaving equipment and facilities and emergency management amongst other topics.

With respect to water safety signage, the Australian Coastal Public Safety Guidelines provide information on signage and coastal signage systems and beach flags. In particular the document provides guidelines for the selection, use and placement of coastal safety signage. It is noted, however that the provision of coastal and water safety signage and beach safety flags should not replace the need for safety education and instruction, accident prevention training or the provision of lifeguards [51].

Australian Standards (AS)

AS provide highly technical information on a range of specific topics. With respect to signage, Australian Standards (AS) has established a nationally consistent set of guidelines surrounding the appearance and provision of water safety signage and safety signage in general. There are a number of AS relevant to the issue of water safety signage:

- AS2342 – Development, testing and implementation of information and safety symbols and symbolic signs (further information can be found in Appendix 2: AS2342 – Development, testing and implementation of information and safety symbols and symbolic signs (précis))[17].
- AS2416 – Design and Application of Water Safety Signs (further information can be found in Appendix 3: AS2416 - Design and Application of Water Safety Signs (précis)) [2].
- AS/NZS4360 – Risk Management (further information can be found in Appendix 4: AS/NZS4360 – Risk Management (précis)) [40].
- AS1319 – Safety Signs for the Occupational Environment (further information can be found in Appendix 5: AS1319 – Safety Signs for the Occupational Environment) [4].

Guidelines for Safe Pool Operation (GSPO)

The GSPO was released in August 1991 after extensive consultation and discussion with industry (GSPO: pg1) [38]. The Guidelines represent a practical tool for obtaining best practice in a broad range of areas relevant to the operation of an aquatic facility. Areas covered within the GSPO are:

- General operations
- Technical operations
- First aid
- Facility design
- Supervision
- Programs
- Low Patronage Pools.

The GSPO is subject to ongoing review and makes reference to the legislative instruments/framework that exists for pool operators. These Guidelines "…have no formal, legal or regulatory status; rather they are intended to be a voluntary guide…" (pg 1) [38].

National Aquatic and Recreational Signage Style Manual 3rd edition

Lifesaving Victoria has created the National Aquatic and Recreational Signage Style Manual 3rd edition. These guidelines for the design and application of advisory water safety signage were established for use at beaches, public pools and other natural waterways.

This signage style manual gives a guide to managers/owners as to a best practice signage system that utilises risk management principles as well as existing standards for aquatic and recreational signage. The system aims to "…give a uniform message to users on the risks associated with a particular location or body of water so as they may make informed decisions…" (pg 9) [3].

The manual details seven different areas for water safety signage such as: road signs, car park signs, access signs, individual hazards and regulatory signs, beach signs, flags and symbols, marine stinger signs and pool signs. The manual also details sign layout, by "…favouring a hierarchical layout which includes location identification, hazards and warnings, information, regulations and facility manager…" (pg 16) [3].

The manual also discusses location and height of proposed signage as well as any existing visual distractions, which can all contribute to the effectiveness of assign when it is installed [3].

Statewide Mutual: Signs as Remote Supervision

Statewide Mutual was established in 1993 with 96 members. Membership has since expanded to include councils, the local government association, the shires association and other boards [52].

'Signs as Remote Supervision' is a best practice manual created by Statewide Mutual primarily for use by local councils and land managers. This document provides information on relevant Australian Standards to be adhered to, as well as "…detailing a process for council facilities to follow in order to assess risk and determine the most appropriate sign for use…" (pg 7)[15].

There is also a rating scale for natural reserves, beaches and pools to determine the facility visitation rate and thus, to select, produce and locate an appropriate sign [15]. The Signs as Remote Supervision best practice manual differs from other manuals as it does not dictate what a sign should look like, it dictates what should be included on the sign and provides examples of different types of signs already in use [15].

Appendices

Appendix 1: Legislation

State and Territory legislation confers duties on managers/owners to provide and maintain safety signage. Duties associated with occupational signage and water safety signage and the relevant legislative documents are discussed below:

Occupational Signage

Occupational signage is defined as signage used to provide information or alert staff and visitors to hazards at a workplace. Specific to the provision of signage at a public swimming pool, Occupational Health and Safety (OHS) Acts and Regulations, Dangerous Goods Acts and Regulations, Hazardous Substances legislation and Public Health Guidelines all confer legislative duties on pool operators to provide occupational signage [53]. This signage includes: emergency and evacuation signage, first aid signage and HAZCHEM signage provided for any dangerous goods or hazardous substances stored or used at a place of work.

OHS legislation also outlines the legal duty of employers and people in control of workplaces to undertake a risk assessment to identify and manage hazards and their associated risks to health and safety.

Though not a legislative document, the GSPO also outlines both legislative and best practice requirements for the provision of occupational signage for public swimming pools.

Water Safety Signage

Local governments under local government legislation (such as Local Government Acts) have the ability to erect signage, which may include water safety signage.

Appendix 2: AS2342 – Development, testing and implementation of information and safety symbols and symbolic signs (précis)

This document details the principles and procedures for the design, selection and testing of graphic symbols for use: on equipment to advise on use and operation; used in locations where people work, assemble or move to provide information or instruction such as prohibitions, warning, rules, limits, directional guidance; or to be used in pictorial representations such as maps, plans, drawings, illustrations and similar documents (AS2342: pg 5)[17].

AS2342 is divided into several sections that detail the process of creating a symbol from the determination of need, design, selection and testing of the symbol through to siting and maintenance.

Determination of need for a symbol

AS2342 states that symbols are only to be used when appropriate. The determination of need is an important element to the development of an effective symbol and aims to prevent a proliferation of symbols as this can lessen the impact (pg 7)[17].

If no other course of action can be undertaken, such as eliminating the hazard, an establishment of need form may be filled in. The applicant provides a number of symbols that may be used for testing. These symbols will traditionally be provided from established sources, but it may also include new symbols if they have been designed in accordance with AS2342 (pg 7)[17].

Design of a symbol

A designer, when designing a new symbol or modifying existing signs, will need to take into account the following:

- Typical locations for the signs as well as any background objects, as these can influence the legibility of symbols.
- Illumination of the symbol may also need to be addressed.
- Legibility distance, that is factors affecting the distance at which a symbol needs to be legible, this may include who the users are (such as motorists etc).
- Communication, that is, whether the symbol needs to compete with other graphic devices or if a symbol can be readily distinguished from similar images.
- Appropriate sign classification such as whether a symbol is to be used in more than one class of sign such as information sign and mandatory sign for example (pg 8).

Selection and testing of recognition/comprehension of a symbol

Steps to be followed are:

- Collection of symbol variants: included in this are to be all symbols in widespread use internationally.
- Appropriateness assessment test: variants are reduced to a short list of three for testing purposes.
- Comprehension test: where responses are sought from subjects under controlled conditions as to the meaning of the symbol or sign. Responses are placed into one of five categories and a sign shall be accepted if it: has at least 85% correct or nearly correct responses (category 1), not more than 5% opposite or potentially hazardous responses (category 4) and not more than 10% wrong responses in total (categories 3 plus 4). See AS2342 Appendix C for comprehension and recall tests info (pg 9).
- Recall test: applied only to a symbol or symbolic sign that failed the comprehension test after all attempts to design a symbol that will pass the comprehension test have failed. The test involves

showing proposed signs to a group of subjects as for comprehension testing, explaining their meaning and repeating the comprehension test using the same subjects three days to two weeks later. This test aims to determine how easily the meaning of the symbol or the sign may be learnt (pg 11).

Principles for the design of graphic symbols (AS2342: pg 12)

- Symbol proportions: narrow symbols can create problems of legibility and comprehension and are to be avoided. Symbols should be designed so that the ratio of the lengths of adjacent sides of a rectangle just enclosing the symbol does not exceed 2:1.
- Significant detail: details dimensions that aim to ensure symbols are legible when viewed at small subtended angles.
- Symbol form: symbols are to be solid rather than outline
- Directional characteristics: when symbols are combined with direction arrows for example, symbols are to align with arrows (pg 12).
- Contract: design of the symbol needs to ensure that symbol/background contrast can be reversed

Principles for the design of signs incorporating symbols

- May be symbolic or composite signs (multiple symbols, symbols and words or symbols and directional arrows) (pg 14)
- Details design elements to be taken into consideration for both types of signs.
- Also details measures to enhance the conspicuousness of a sign such as: increasing the size, use of reflective materials, environmental background (symbols and signs to be of contrasting colour to the environment), internally lit signs, improved siting (pg 15).
- Viewing of signs under natural and artificial light (pg 20)

Siting and Maintenance

The siting of signs is an important consideration as correctly positioned signs are more effective at conveying their message(s) to the intended user (pg 22) [17]. Warning signs need to be placed in relation to the particular hazard.

- Gives direction for the siting of both indoor and outdoor signs (pg 22).
- And instruction as to how to avoid overuse of signage (pg 23).
- Maintenance includes: avoiding colour fade in both natural and artificial lighting (pg 23).

To be included within the Standards signs are tested for comprehension under AS2342. Tests whether the sign is sufficiently self evident along a set of pre-determined criteria.

- AS2342 says symbols are able to convey a message more quickly and efficiently than text, at being legible from longer viewing distances and as being readily understood by people who are poor readers of English (pg 4). However some situations may require the display of text rather than symbols, to provide a more effective form of communication (pg 4).

Appendix 3: AS2416 - Design and Application of Water Safety Signs (précis)

AS2416 details requirements for the design and application of beach flags and water safety signs, including those signs that incorporate graphic symbols. The Standard states that signs and flags are to be used where water sports may be undertaken, or where there are other activities that may occur close to bodies of water, such as seaside, rivers, creeks, dams and open drains (AS2416: pg 5) [2].

The aim of AS2416 is to reduce the risk of drowning and serious accidents by providing a uniform basis for identification of: hazardous conditions associated with a body of water or water sports, areas on beaches patrolled by lifesavers or lifeguards, areas where certain water sports are prohibited or permitted, and the location of first aid and rescue equipment (pg 5) [2].

This standard only sets out symbols to be used if they have passed the AS2342 process.

Information is provided for the design and use of flags within AS2416.

- Flags for use on beaches and at waterways are to be designed in the format detailed in Table 2.1 This sets out style, size, colour and function for 4 different kinds of flag (pg 7).
- Includes flags for communicating: a patrolled beach with swimming permitted, that a specified area is closed to swimming, to indicate a boundary within the water such as where swimmers are permitted to swim and where surfboards may be ridden and underwater diving flag (international symbol) to warn boats divers are below the surface (pg 8).

Design and use of signs

- Assessment is to be undertaken to ensure the use of the sign is appropriate and that it can be readily understood and conveys accurately the message that needs to be conveyed (pg 9).
- Illustrated appendices outline symbols that have met the testing requirements of AS2342 and therefore any sign used should be chosen from this set (pg 9).
- Table 3.1 outlines colour and shape requirements for symbolic signs (pg 11).
- The design of single symbolic signs, symbolic signs on target boards and multiple symbolic signs are also outlined (pg 13).
- Signs using words only are to adhere to specific colours in the design of a sign. Categories of signs often have specific background colours for e.g. red for fire and blue for information (pg 15).
- Letter size is also specified to ensure legibility, and there are different provisions for poorly lit conditions. How to determine poorly lit as there is no measure (pg 16).
- Also details construction, erection and removal of signs. For example signage should be removed immediately if it no longer contains correct information (pg 18).
- There are also special requirements for specific signs such as the unpatrolled area warning sign and the swimming not advised signage (pg 19).
- Appendices outline styles and types of signs that are to be used and their meaning.

Appendix 4: AS/NZS4360 – Risk Management (précis)

- Provides a generic framework for establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk.
- Risk management, to be effective, should be ingrained within an organisation's culture.

Appendix 5: AS1319 – Safety Signs for the Occupational Environment

AS1319 documents signage to be used within an occupational environment with the aim of regulating and controlling safety related behaviour, to warn of hazards and to provide emergency information including fire protection information (pg 5) [4]. Design requirements for safety signage, such as the colour and shape requirements for symbolic shapes are included in this Standard.

This Standard includes information on the construction, installation and maintenance of signage, including erection and removal of signs, the illumination of signs and the number of signs that are to be used (pg 20) [4]. A section of this document is also devoted to accident prevention tags for use on plant, equipment or other objects and aim to advise users on safety aspects of the object (pg 21) [4].

AS1319 sets out design requirements for safety signage including colour and shape requirements for symbolic shapes and states that signage should be provided in tandem with appropriate accident prevention measures, and a risk management approach (pg 7) [4].