



Issues Paper

# Recreational Scuba Diving & Snorkelling Safety in Australia:

*An identification, summary and analysis of policies, legislation and standards relevant to recreational scuba diving and snorkelling*

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## Executive Summary

This paper aims to identify, summarise and analyse the relevant policies, legislation and standards that relate to recreational scuba diving and snorkelling in Australia.

Scuba diving and snorkelling (diving) are exhilarating recreational activities, participated in and around most of the Australian coastline by both Australian and international tourists. However, both can be challenging with drowning deaths, deaths from other causes, and other serious injuries occurring.

In 2004, the Australian Water Safety Council (AWSC) and associated State and Territory water safety groups, created the National Water Safety Plan (NWSP) 2004-07. As part of the plan a recommendation (17) was made "...That an analysis of State and Territory water safety related legislation be undertaken to identify and report on areas of inconsistency/ or deficiency..."<sup>1</sup>. Recreational scuba diving and snorkelling as an activity with a risk of drowning and regulated at a State and Territory level was chosen as one of the areas to explore.

Diving is conducted in a potentially hostile environment and as such has inherent risks. These risks include: lack of familiarity with the environment; lack of familiarity with equipment, or equipment failure; inadequate physical fitness; inadequate medical fitness; human error and violations of safety rules; attitudinal, marine animals; and boats.

It is essential that divers be made appropriately aware of these risks prior to participation. Risks can be reduced through adequate education and training, ensuring 'fitness' for diving, appropriate supervision, appropriate and functional equipment and common sense.

The number of deaths of scuba divers and snorkellers has increased significantly over the past 30 years, almost doubling since the 1980's. In Australia, the mortality rate of scuba divers can be estimated to be 0.57/100,000 dives. Though obtaining a reliable estimate proved difficult, if the estimate of 0.57/100,000 dives is reliable, it compares favourably with reported scuba diving mortality rates in other countries.

Research identified a recent increase in mortality rates among the ageing diver population, which is a trend that requires attention. Inexperienced divers diving in unfamiliar conditions, divers who have not dived for extended periods of time and the high accident rate among untrained divers in WA and Tasmania using hookah/SSBA for underwater fishing are also issues that require further attention.

There are a variety of Standards, Regulations and/or Codes of Practice that apply to recreational diving and snorkelling activities in Australia. These include: ISO standards for the training of recreational scuba divers

and voluntary international dive training standards propagated by training agencies at an International level. Nationally there are a variety of Australian Standards that aim to regulate activities and equipment used to ensure safety such as the AS 4005 – 2002 series which relate to the training and certification of recreational divers.

At a State and Territory level within Australia, there are OHS Regulations in each State and Territory that apply to diving and Codes of Practice in Queensland and WA and a voluntary dive industry Code of Practice in Victoria.

Although research has found that Australia has a relatively good track record for diving safety, there are a number of measures that could possibly be implemented to improve safety further. Such measures should only be considered after appropriate consultation and discussion and with support of the industry. These may include:

- Maintain existing Australian Standards for the training of recreational scuba divers and dive professionals, rather than adopt the less stringent ISO or RSTC Standards.
- Investigate various means of improving awareness of and compliance with AS/NZS 2299.3, the Standard for the conduct of recreational diving activities involving an occupational component.
- Should the above be achieved through the introduction of a National Code of Practice for the conduct of safe recreational diving operations, it should cover organised recreational and educational groups and should also specifically address snorkelling activities.
- Should the government of any State or Territory recognise the need to operate at a higher standard, then the National Code of Practice could be strengthened or resources provided to monitor or enforce compliance on similar lines taken to the approach in Queensland.
- Regulate to restrict the purchase of diving equipment which carries identified risks over and above those associated with normal recreational scuba equipment to those who have evidence of appropriate training.
- Provide support for programs designed to educate divers about the importance of maintaining diving health and fitness and the need for appropriate periodic diving medical re-assessment.
- Provide support for the establishment of an appropriate 'Diver Health Registry' through which divers can conduct self-assessments and can be referred to diving medical expertise as required.
- Provide support for on-going research and monitoring of diving safety. Support and enhance appropriate measures to increase the availability of technology that could improve diver safety, such as diver location and emergency call devices.

## Contents

Executive Summary .....	1
Contents .....	3
Introduction.....	4
Risks of Diving.....	4
Aims .....	5
The Diving Population.....	5
Diving Accidents in Australia .....	7
Fatalities .....	7
Trends in Diving Fatalities.....	8
Decompression Illness.....	10
Incidence of Morbidity and Mortality .....	12
Identification, Summary and Analysis of Regulations, Legislation and Standards Specific to Diving .....	13
International Standards.....	14
National Standards .....	15
State and Territory Regulations.....	17
Occupational Health and Safety Regulations .....	21
Surveying industry views on diving safety.....	23
Summary.....	24
Discussion .....	26
Recommendations to Improve the Safety of Snorkelling and Scuba Diving in Australia.....	27
Contributors .....	28
Acknowledgments .....	28
Suggested Citation.....	28
Glossary .....	29
References .....	31
Appendix A: Surveying Industry Views on Diving Safety .....	34
Responses.....	34
Appendix B: Divers Alert Network (DAN) .....	41

## Introduction

Scuba diving and snorkelling (diving) are exhilarating recreational activities, participated in around much of the Australian coastline by both Australians and international tourists. However, both can be challenging and accidents can and do occur, with a resulting incidence of serious injuries or fatalities.

In 2004, the Australian Water Safety Council (AWSC) and associated State and Territory water safety groups, created the National Water Safety Plan (NWSP) 2004-07. As part of the plan a recommendation (17) was made "...That an analysis of State and Territory water safety related legislation be undertaken to identify and report on areas of inconsistency/ or deficiency..."<sup>1</sup>. Recreational scuba diving and snorkelling as an activity with a risk of drowning and regulated at a State and Territory level was chosen as one of the areas to explore.

There are reports of people snorkelling in Australia since at least the 1920's. However, a diving industry began to emerge in Australia in the 1960's. Participants were mainly experienced breath-hold divers who were generally comfortable in the water and who possessed reasonably sound water survival skills. However, subsequently, as the broader community has become more aware of the beauty of the underwater world, there are many more participants with relatively poor aquatic skills, and sometimes relatively poor health and fitness. Unless this is carefully managed by appropriate and adequate participant screening, training, supervision and accident management systems, it can be a recipe for significant morbidity and mortality.

## Risks of Diving

The causes of diving accidents are many, and may include:

- *Lack of familiarity with the environment.*  
Divers may encounter problems as a result of currents, poor and/or changing surface conditions, differing water temperatures and visibility, increased depth and lack of direct access to the surface.
- *Lack of familiarity with equipment, or equipment failure.*  
Water is unrespirable and so the diver is reliant on equipment to enable them to breathe effectively. The new or infrequent participant may have problems using unfamiliar equipment and so make errors that contribute to an accident. In addition, equipment may be faulty and so precipitate an accident<sup>2</sup>. Rebreathers, which have been increasing in popularity over recent years, have some inherent dangers and require a greater level of understanding, maintenance and vigilance than open circuit scuba equipment.
- *Inadequate physical fitness.*  
Diving in currents, poor surface conditions or cooler waters, especially when wearing heavy equipment and/or tight wetsuit can put a person under significant physical stress which can lead to exhaustion. Unless this is managed appropriately, there is an increased potential for an accident.
- *Inadequate medical fitness.*  
Certain medical conditions can predispose a diver to an accident. Conditions, such as epilepsy, which can cause rapid unconsciousness, are incompatible with safe diving. There is an increasing incidence of cardiac-related death among the ageing diving population. A variety of other conditions, such as asthma and diabetes, may be contraindicated, and sufferers need to be carefully reviewed by a physician trained in diving medicine to assess their level of risk.
- *Human error and violations of safety rules.*  
Divers, like other humans, make errors from time to time due to fatigue, inexperience, poor

judgment and various other factors. In addition, some divers violate dive safety guidelines through lack of appreciation of, or belief in their efficacy, a belief that they do not apply to them, among other reasons<sup>3</sup>.

- *Attitudinal.*  
With the emergence of technical diving and the ability to dive far deeper and longer than before, some divers are pushing extreme boundaries and are therefore at a greater risk of a potential mishap. Some argue that with the emergence of the deeper diving, there has been an associated resurgence of machismo among certain participants. This can also increase the potential for accidents.
- *Marine animals.*  
Occasionally divers are seriously injured or killed by an encounter with a potentially dangerous marine animal such as a shark, stingray or jellyfish. Such accidents can sometimes be prevented by appropriate planning and preparation.
- *Boats.*  
Motorised vessels pose a potential danger for divers and serious injuries do occur. Divers usually use flags and buoys to enhance their visibility in the water. However, boat operators do not always see divers. Others may not be aware of, or may ignore, the requirement to stay a safe distance from divers.

In the view of this author, safe diving requires an adequate understanding of the risks involved, adequate medical and physical fitness, appropriate training, suitable and reliable equipment, and a good dose of common sense.

## Aims

This documents aims to:

- Provide background information on diving safety in Australia
- Identify, summarise and analyse regulations, legislation and standards relevant to scuba diving in Australia

## The Diving Population

### Certifications

The first national study of the Australian scuba diving industry, published in 1989 reported that there were 50,550 new scuba divers certified in 1988<sup>4</sup>. By 1991, this had risen to 54,153<sup>5</sup>. However, in 2007, this figure had dropped to around 48,000<sup>6</sup>.

### Dives conducted

Diving safety experts throughout the world have strived for years to obtain reliable estimates of the risk of diving. It is possible in some places, such as Australia, to determine with reasonable accuracy, the annual number of diving fatalities, or divers treated for decompression illness (DCI). However, the most elusive statistic has been a reliable estimate of the number of dives conducted, the required denominator on which to base an estimate of risk.

During the 1993-94 financial year, the Victorian dive industry conducted a survey of tank filling stations and it was estimated that there were approximately 77,706 tank fills that year<sup>7</sup>. Accounting for divers who had their tanks filled privately, it was believed that around 80,000 dives may have been performed in Victorian

waters that year. It was estimated that, in 1994, approximately 1.3 million scuba dives were conducted on the Great Barrier Reef <sup>8</sup>.

The dive industry experienced a boom in the mid 1980's to mid 1990's but is generally believed to have decreased since that time due to economic changes, competition from other recreational activities and some well-publicised adverse incidents.

A recent report surveyed the diving activities of overnight visitors to Queensland between 1 April 2006 and 30 March 2007. Around 1.2 million international and domestic overnight visitors undertook scuba diving and snorkelling activities while in Queensland. 345,000 (comprising an estimated 143,000 domestic visitors and 202,000 international visitors) of these were scuba diving and 1,119,000 snorkelled <sup>9</sup>. In this report, it was estimated that a minimum of around 1.2 million scuba dives and 2.3 million snorkel dives were conducted throughout Queensland over that period. This figure is exclusive of locals who went diving and did not stay in a hotel. However, one issue of concern with this report is that the sample size for domestic tourists who dived was very small and, therefore, possibly unreliable. (See comments below.)

There is relatively little information about the number of people who participate in diving activities in parts of Australia other than Queensland. However, the annual Participation in Exercise, Recreation and Sport (ERAS) reports, which survey exercise involvement in people over 15 years of age, indicated a participation rate of 0.5% for scuba diving in both 2005 <sup>10</sup> and 2006 <sup>11</sup>.

In these surveys, the estimated number of people who scuba dived in 2005 was 86,800 (with a 95% confidence interval of 64,636-108,964), and 78,300 (with a 95% confidence interval of 57,190-99,410) in 2006. However, interestingly, even at their upper 95% limits, these National estimates are substantially lower than the estimate of domestic tourists (143,000) who dived in Queensland in the following year and so creates concerns about the reliability of the various estimates.

The ERAS surveys also estimated that the mean number of dives conducted by the diving group was 12 in 2005 and 12.1 in 2006. This indicates an annual dive estimate of 1,041,600 in 2005 and 947,430 in 2006 for Australian residents, the average over the two years being 994,515 dives.

If we assume that: (1) the ERAS two-year average for the number of dives done by residents is a reasonable estimate; and (2) the Queensland estimate of dives by international tourists (750,000) is reasonable and was similar over recent preceding years; and (3) we can ignore diving tourists to other States, of which there are relatively few compared to Queensland we can estimate that around 1.75 million scuba dives were conducted in Australia in 2005. (This author believes that this rate is conservative and that the real rate may be closer to 2 million, or higher.)

## Diving Accidents in Australia

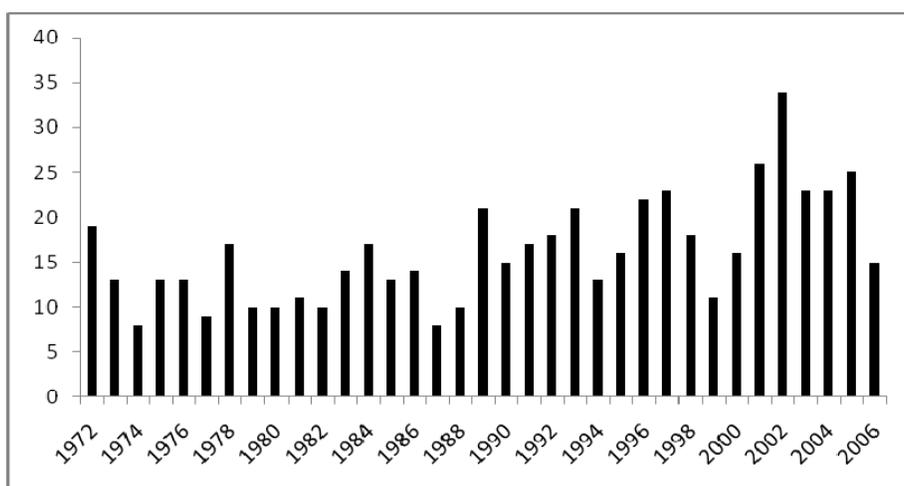
### Fatalities

Figure 1 shows the number of currently recorded Australian diving fatalities per year from 1972 to 2006<sup>12-17</sup>.

The data for 2002 onwards is provisional as it is likely that some additional cases will be added, especially in the later years. As can be seen, there appears to have been a rise in fatalities from around 1989 onwards.

In all, there were a total of 566 recorded diving fatalities during that period. Table 1 shows the mode of diving they were involved in; i.e. scuba, snorkel, hookah, rebreather and unknown. It should be noted that many of the divers using hookah may not have been diving recreationally.

**Figure 1: Recorded dive fatalities in Australia from 1972-2006.**



**Table 1 Mode of diving for dive fatalities**

Mode of Diving	Number
Scuba	290
Snorkelling	194
Hookah	62
Rebreather	6
Unknown	14
<b>Total</b>	<b>566</b>

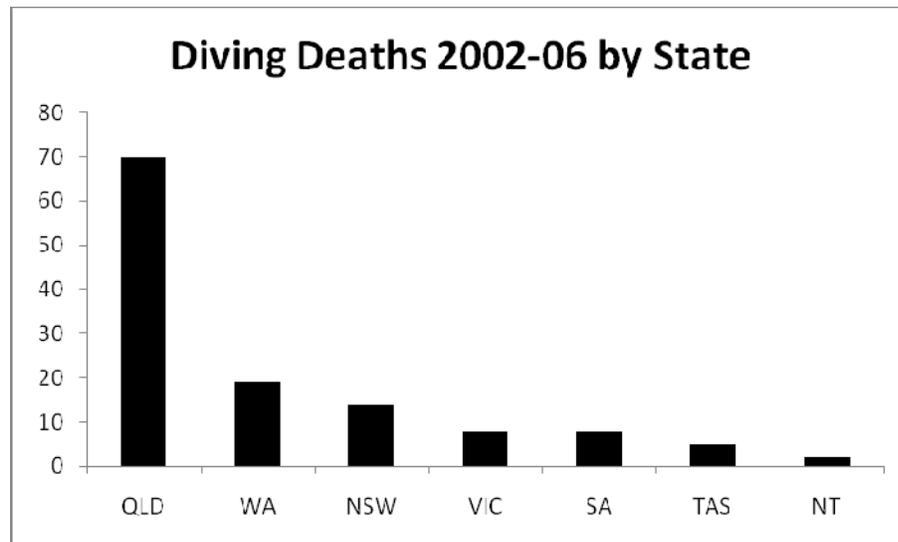
The average number of fatalities per decade has increased from 12.6 (1972-79) to 23 (2000-06) (Table 2).

**Table 2 Average deaths per period**

Years	Average Deaths
<b>1972-79</b>	12.6
<b>1980-89</b>	12.8
<b>1990-99</b>	18.4
<b>2000-06</b>	23

Figure 2 shows the number of recorded diving fatalities in various Australian States and Territories between 2002 and 2006 inclusive. The large proportion in Queensland is undoubtedly reflective of the far higher diving activity rate in that State.

Figure 2 Deaths by States & Northern Territory 2002-2006.



## Trends in Diving Fatalities

### The Ageing Diver

Divers Alert Network data indicate that an increasing number of snorkelling and scuba diving fatalities are occurring in older participants (Figures 3 -6). A large proportion of these deaths were due to cardiac causes<sup>18</sup>. This is a trend currently seen worldwide and is probably a reflection of a greater proportion of older people participating in snorkelling and scuba diving than in earlier years. This trend indicates the increasing importance of appropriate medical screening for participants, whether by questionnaire, medical examination, or both. The Divers Alert Network is currently exploring the costs and viability of establishing such a system in Australia.

### The Inexperienced and/or Out-of-practice Diver

A concerning number of diving accidents involve inexperienced scuba divers who are diving in sea conditions different to those in which they were trained. For example, a diver who has been trained in warm, generally clearer, tropical waters, and has had little subsequent experience, can face substantial problems initially while diving in colder waters, where there is often poorer visibility, and where they are required to wear a thicker wetsuit, or a drysuit, and more weights to compensate for this.

Divers who have not been diving for extended periods need to re-introduce themselves with appropriate refresher dives in relatively easy conditions, to re-familiarise themselves with their equipment and refresh their skills prior to participating in more challenging dives.

### The Deep, technical diver

The last ten years or so has seen the emergence and growth of technical diving in Australia. Technical diving is recreational diving using breathing gases other than air and/or diving that requires mandatory decompression stops. This often requires equipment additional to that carried for normal recreational diving. A proportion of these divers perform very deep and potentially hazardous dives, sometimes using 'rebreathers'. Rebreathers are underwater breathing devices designed to enable the diver to re-breathe expired gas by the extraction of carbon dioxide and the addition of supplemental oxygen.

The accident rate in this group of divers appears to be relatively high including many cases of decompression illness and several fatalities.

Figure 3 Percentage of breath-hold deaths in each age group in the 1999-2003 period compared with the 1972-1993 period.

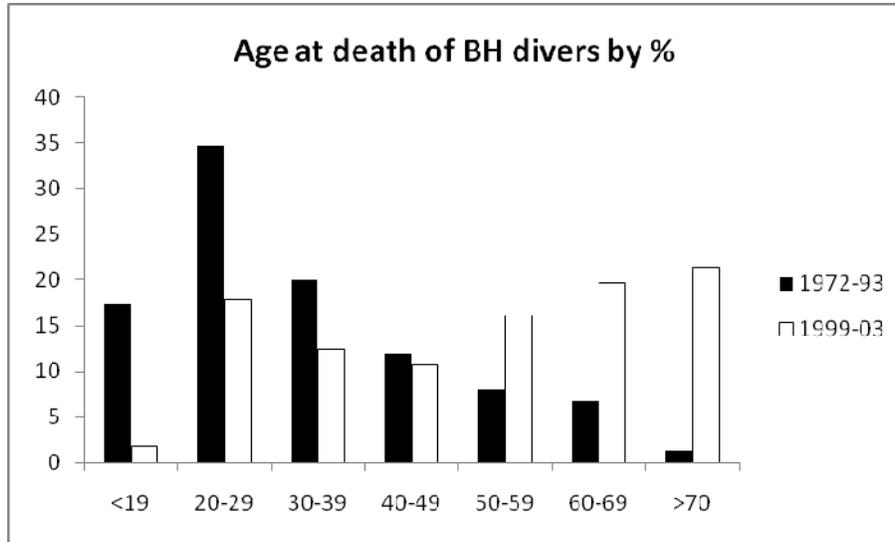


Figure 4 Type of incident for breath-hold divers 1999-2003. ("Other drowning" represents unspecified drowning; "other" = 1 cerebral haemorrhage, 2 seizures, 1 asphyxiation with pulmonary oedema).

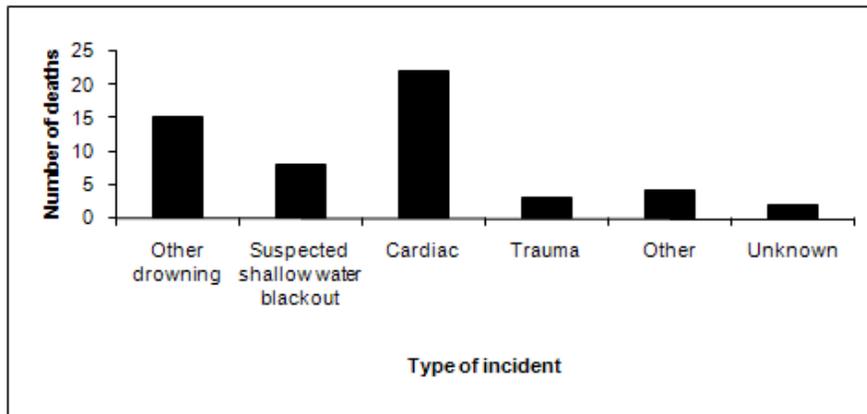


Figure 5 Percentage of the total Scuba deaths for each age group in the 1972-1993 (n=178) period compared with the 1999-2003 (n=45) period.

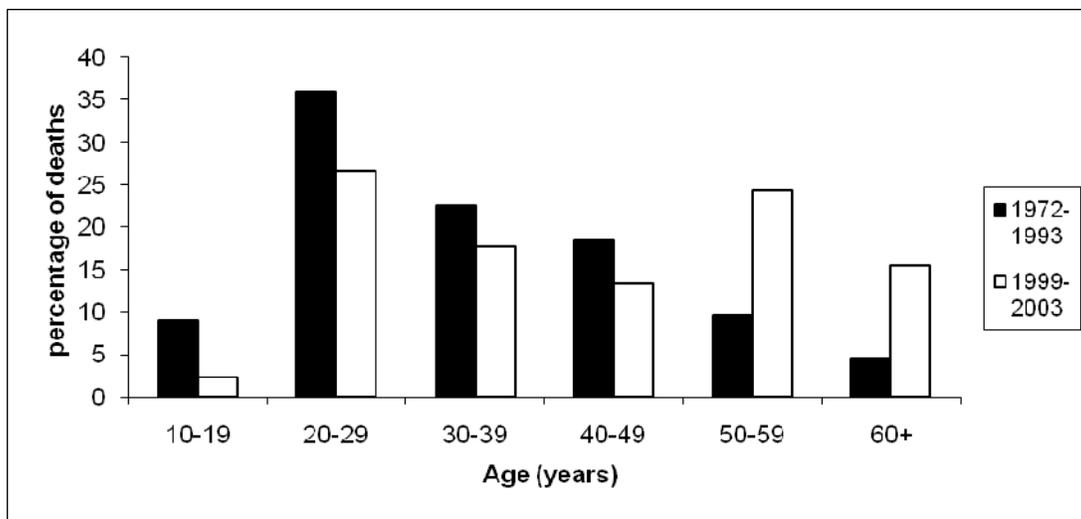
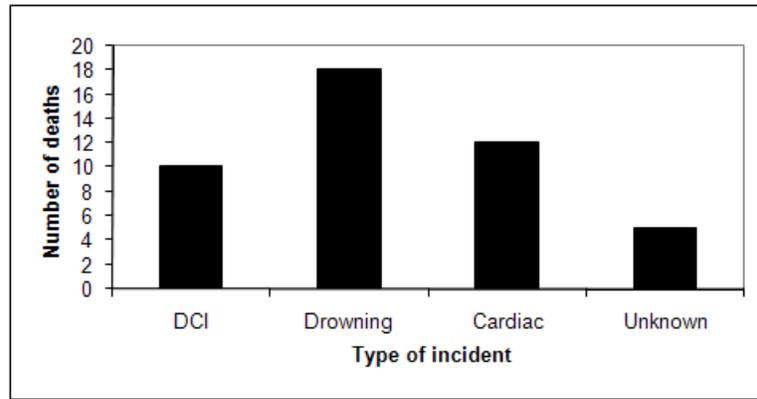


Figure 6 Type of incident, 1999-2003: SCUBA (n=45)



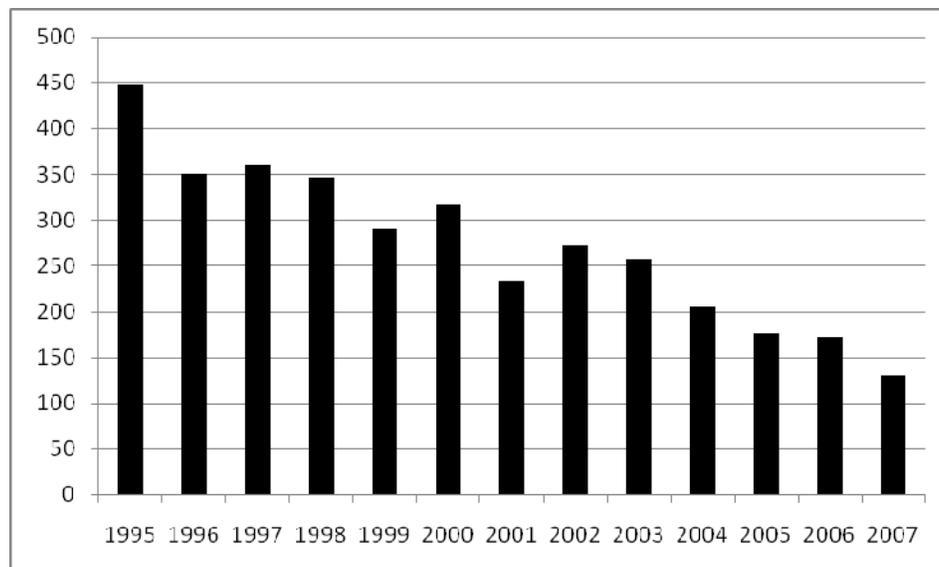
### Decompression Illness

Decompression illness (DCI) is an ever-present potential hazard of compressed gas diving. Manifestations can be relatively mild, such as fatigue, body aches or mild paraesthesia; or severe, such as paralysis or death. Approximately 30% of divers treated for decompression illness are left with residual symptoms which can take weeks or months to resolve, if ever. Prompt recognition, and rapid and appropriate first aid and treatment may reduce the severity of symptoms, the amount of treatment required, and the likelihood of residual symptoms<sup>19</sup>.

There were a total of 3,558 divers treated for DCI in Australian chambers during the various financial years between 1995 and 2007<sup>20-32</sup> (Figure 7).

There has been a substantial reduction in DCI cases treated over the later years. This is likely to be due in part to reduced diving activity. However, it may also be reflective of better diver education and decompression accident prevention strategies, and possibly equipment such as dive computers that help to control ascent rate.

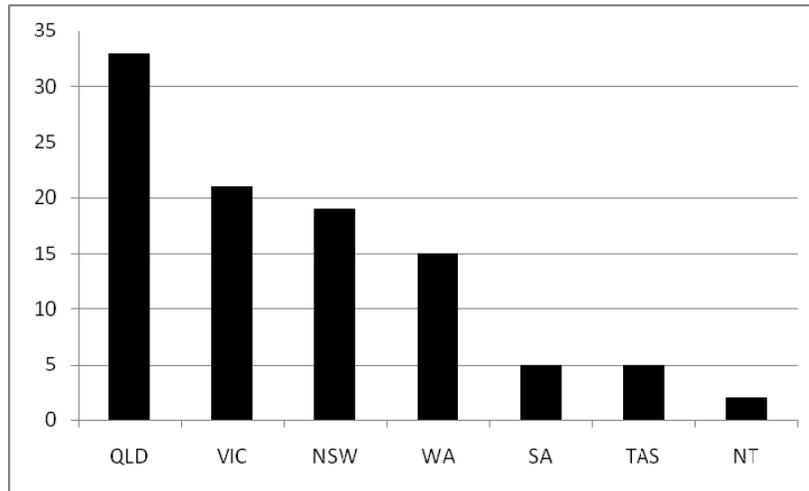
Figure 7 Divers treated for Decompression Illness in Australia from 1995-2007.



Between 1995-2007 Queensland had the highest percentage of DCI cases followed by Victoria and NSW (Figure 8). Interestingly, the diving industry in Victoria is smaller than in NSW (ERAS Surveys<sup>10 11</sup>), however

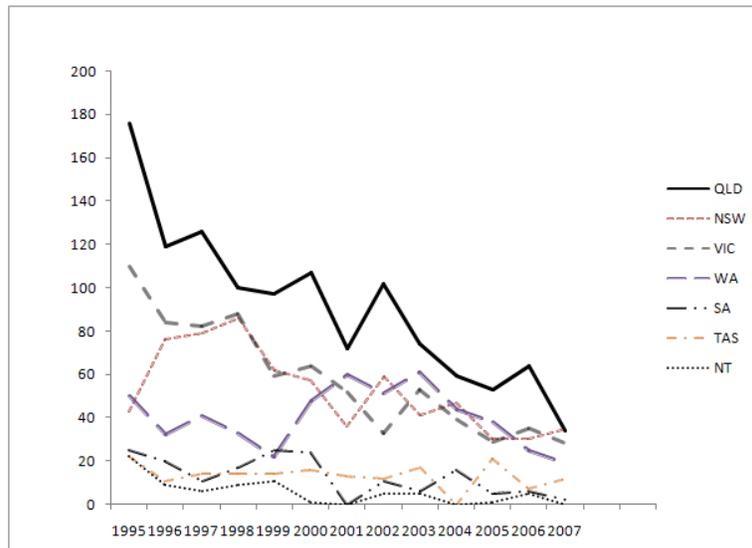
more divers have been treated for DCI in Victoria. This could be a result in part from more demanding diving conditions (e.g. colder water), easier accessibility to a chamber and possibly a lower diagnostic threshold for treatment of the dive physician, among other factors.

**Figure 8 Percentage of DCI by States & Territories**



There has been a decline in all States and Territories (excluding the ACT where divers are not treated for DCI) over time in the number of divers treated for DCI between 1995-2007 (Figure 9).

**Figure 9 DCI Treatment by State and Territory, 1995-2007**



## Incidence of Morbidity and Mortality

### Fatalities

Between 2002-2006 there was an average of 10 scuba-related and 12.4 snorkel-related fatalities per year in Australia<sup>12</sup>.

Working on the basis of 1.75 million dives conducted in Australia in 2006 (and assuming that this is typical for the past few years), and the average annual scuba fatality rate of 10, gives an estimated scuba fatality rate of 0.57/100,000 dives. This compares favourably with some other published rates, such as 2.05/100,000 in BC Canada in 2005<sup>33</sup>; 11-18/100,000 in DAN America Members between 1997-2004<sup>34</sup>; 3.6-5/100,000 in the UK in 2006<sup>35</sup>; 2.9/100,000 in Stony Cove, UK<sup>36</sup>.

Of note, the estimated scuba diving fatality rates for Australia are well below the other estimates shown here. This may be due to several factors which include, among other factors:

- a. Variations in dive conditions. The Canadian and UK data evolved from predominantly cold water diving which is generally more demanding. The bulk of diving in Australia is conducted in more temperate or tropical conditions which are more conducive to safe diving.
- b. Better controlled diving in Australia as a whole, or in parts of Australia.

To further investigate differences within Australia itself, we can use the 1993 and 1994 surveys from Victoria and Queensland mentioned earlier<sup>7 8</sup> to provide a denominator to estimate the fatality rate in these States at that time. The five year average of diving deaths in Victoria and Queensland from 1992-1996 were 2 and 6.4 respectively<sup>13 14</sup>. If we assume that the diving activity in these States over the five-year period was similar to the years surveyed, this yields fatality rates of 2.5/100,000 for Victoria and 0.49/100,000 for Queensland.

It is likely that this fivefold difference is largely due to different diving conditions, but may also reflect different diving patterns and possibly an effect of regulation in Queensland.

### Decompression Illness

In Australia, between 2002-2006, an average of 188 divers were treated for DCI each year. In Queensland, this five-year average was 56.5<sup>27-31</sup>. Using the basis of 1.75 million scuba dives Australia-wide this yields an estimated DCI rate of 10.74/100,000 for Australia.

By comparison, DAN America data collected between 1998 and 2004, the DCI incidence rate among warm water divers fluctuated from 0-50/100,000 dives<sup>34</sup>.

## Identification, Summary and Analysis of Regulations, Legislation and Standards Specific to Diving

This chapter identifies, summarises and analyses regulations, legislation and standards specific to diving. A summary of International, National and State and Territory based standards, regulations and codes of practice relevant to recreational diving and snorkelling in Australia are presented (Table 3) as well as a discussion of the content and scope of relevant standards and regulations.

**Table 3 Summary of Standards, Regulations & Codes of Practice relevant to recreational diving and snorkelling in Australia**

	<b>STANDARD (Administered by)</b>	<b>REGULATION / CODE OF PRACTICE</b>
<b>International</b>	<b>ISO/TC 288 – 2007</b> (ISO) <b>RSTC</b> (Major recreational diver training agencies)	
<b>National</b>	<b>AS 4005 : 2000</b> Re: Training & certification of divers and dive professionals (Australian Standards)	
	<b>AS/NZS 2299.3: 2003</b> Re: Conduct of recreational diving and snorkelling (Australian Standards)	
	<b>AS2030.1: 1999 &amp; AS3848.2: 1999</b> Re: Scuba diving cylinders (Australian Standards)	
	<b>AS/NZS 4801: 2001 &amp; HB211</b> Re: OH & S management systems (Australian Standards)	
<b>Queensland</b>		<b>Compressed Air Recreational Diving and Recreational Snorkelling COP 2005.</b> <b>COP for Recreational Technical Diving incorporating EANx diving, Mixed gas diving, Rebreather diving, Decompression diving (using air or other gases) 2005.</b> <b>Part 12 Underwater Diving Work of Workplace Health and Safety Regulation 1997.</b> (Department of Employment and Industrial Relations) <b>Marine Regulations</b>
<b>Western Australia</b>		<b>Diving and Snorkelling COP. Recreational Diving using Compressed Gas and Recreational Snorkelling: 2003.</b> (Dept of Sport & Recreation) <b>State OH &amp; S Regulations</b> <b>Marine Regulations</b>
<b>Victoria</b>		<b>COP for Commercial Providers of Recreational Snorkelling &amp; Scuba Diving Services in Victoria: 2005.</b> (Voluntary COP – Dive industry) <b>State OH &amp; S Regulations</b> <b>Snorkelling, SCUBA Diving and Wildlife Swims. Adventure Activity Standards (AAS). April 2005.</b> (Voluntary Standards for Adventures Activities) <b>Marine Regulations</b>
<b>Other States &amp; Territories</b>		<b>State OH &amp; S Regulations</b> <b>Marine Regulations</b>

## International Standards

There are two main international Standards that impact, or are likely to impact, the conduct of diving in Australia. These are:

### Recreational Scuba Training Council (RSTC) Standards <sup>37</sup>

The RSTC is an organisation that represents the major (predominantly United States-based) scuba training and certification agencies. It has created what it believes to be appropriate minimum training standards for recreational scuba diving training and instruction. These Standards are routinely adopted by most training agencies in countries where no other relevant regulatory framework exists.

*Comment:* The major training agencies in Australia have tried for many years to have the Australian Standards modified to reflect RSTC Standards, but have met resistance from certain other interested parties, such as government departments that conduct diving, some workplace authorities and some parts of the diving industry. Although the current Australian Standards for diver training (AS 4005: 2000) more closely resemble the RSTC Standards than did earlier versions, the Australian Standards are generally still believed to be more stringent in some areas.

### ISO/TC 288 - 2007

The ISO/TC 288 2007 Standards comprise the following:

- *ISO/DIS 24801-1 Recreational Diving Services – Safety related minimum requirements for the training of recreational scuba divers – Part 1: Level 1 – Supervised Diver <sup>38</sup>.*
- *ISO/DIS 24801-2 Recreational Diving Services – Safety related minimum requirements for the training of recreational scuba divers – Part 2: Level 2 – Autonomous Dive <sup>39</sup>.*
- *ISO/DIS 24801-3 Recreational Diving Services – Safety related minimum requirements for the training of recreational scuba divers – Part 3: Level 3 – Dive Leader <sup>40</sup>.*
- *ISO/DIS 24802-1 Recreational Diving Services – Safety related minimum requirements for the training of scuba instructors – Part 1: Level 1 <sup>41</sup>.*
- *ISO/DIS 24802-2 Recreational Diving Services – Safety related minimum requirements for the training of scuba divers – Part 2: Level 2 <sup>42</sup>.*
- *ISO/DIS 24803 Recreational Diving Services – Safety related minimum requirements for recreational scuba diving service provider <sup>43</sup>.*

*Comment:* In 2006, draft Standards for ISO/TC 288 were circulated by Standards Australia for comment to sectors of the recreational diving community represented on the Australian Standards committee involved in recreational diving. The suggestion was that the ISO standards would be likely to replace the existing AS4005-2000, with the aim of achieving greater consistency internationally. Some parties embraced the ISO Standard, while other parties expressed concern that adoption of the ISO Standard would represent an undesirable reduction in certain current minimum requirements in Australia. Of note, the South Pacific Underwater Medical Society (SPUMS) and the Divers Alert Network (DAN) expressed concerns about the potential lowering of the stringency of diving medical fitness assessment.

The Standards were published in 2007 but the final version has not yet been reviewed and discussed by the diving committee involved with Australian Standards. This review is likely to occur later in 2008.

## National Standards

There are a variety of Australian Standards that apply to recreational diving in Australia. These include the following:

### **Australian Standard AS 4005: 2000**

*AS 4005.1-2000 Training & certification of recreational divers Part 1: Minimum entry-level SCUBA diving*<sup>44</sup>.

This Standard was initially developed in 1992 and revised in 2000.

The scope of this Standard is to specify the minimum training activities and terminal objectives required for training and accreditation of persons who wish, for recreational purposes to:-

- (a) Dive safely and competently using scuba in the area in which training is undertaken; and
- (b) Engage in open water scuba diving with a diver of similar qualification without supervision.

The objective of this Standard is to specify the organisational and syllabus requirements to train recreational divers to operate safely and competently to a depth of 18m using scuba.

### **AS 4005.2-2000 Training & certification of recreational divers Part 2: Recreational SCUBA dive supervisor**<sup>45</sup>.

The scope of this Standard is to specify the minimum training activities and terminal objectives required for training and accreditation of persons who may organise and supervise recreational scuba dives, including acting as a certified assistant as outlined in AS 4005.1.

The objective of this Standard is to describe the organisational and syllabus requirements to train recreational scuba dive supervisors to operate safely and competently.

### **AS 4005.3-2000 Training & certification of recreational divers Part 3: Assistant SCUBA instructor**<sup>46</sup>.

The scope of this Standard is to specify the minimum training activities and terminal objectives required for training and accreditation of persons who may assist a scuba instructor in the direction and guidance of trainees and organise and supervise recreational scuba dives.

The objective of this Standard is to describe the organisational and syllabus requirements to train recreational scuba assistant instructors to operate safely and competently.

### **AS 4005.4-2000 Training & certification of recreational divers Part 4: SCUBA Instructor**<sup>47</sup>.

The scope of this Standard is to specify the minimum training activities and terminal objectives required for training and accreditation of persons who may teach recreational scuba divers, and organise and supervise recreational scuba diving activities.

The objective of this Standard is to describe the organisational and syllabus requirements to train recreational scuba instructors to operate safely and competently.

#### **AS 4005.5-2000 Training & certification of recreational divers Part 5: SCUBA instructor trainer** <sup>48</sup>.

The scope of this Standard is to specify the minimum training activities and terminal objectives required for training and accreditation of persons who may teach recreational scuba instructors.

The objective of this Standard is to describe the organisational and syllabus requirements to train recreational scuba instructor trainers to operate safely and competently.

*Comment:* In reality, although the training defined in this Standard is to 18m, the majority of divers with this training dive deeper than this without gaining additional training. It is hoped that before doing so they gain sufficient experience to do so safely, but this is not always the case.

The Australian Standards for training of recreational divers changed considerably over the past 15 years or so. Currently, there is substantially less open water training time, higher instructor-student ratios, among other changes, than was required under earlier versions that evolved from Australia. These current Standards more closely match the guidelines propagated by the RSTC. This has been the subject of some debate and concern by certain parties concerned about a degradation of training standards and the poor quality of divers <sup>49</sup>. As previously mentioned, these Standards are likely to be replaced by, or closely aligned with, the ISO Standards in the near future.

#### **Australian / New Zealand Standard 2299.3: 2003 Occupational Diving Operations. Part 3 Recreational industry diving and snorkelling operations** <sup>50</sup>.

The scope of this Standard is to specify requirements and offer practical guidance for the personnel, equipment and procedures for recreational diving operations using air or mixed gases as the compressed breathing gas supplied through scuba, for recreational diving operations using rebreathers and for recreational snorkelling where these activities occur in a workplace.

The objective of this Standard is to provide persons engaged in, or connected with, recreational diving and snorkelling at a workplace with a set of requirements and guidance to prevent and control risks arising from these activities.

*Comment:* This Standard has been reasonably well-regarded by parts of the diving industry and is referred to in several Codes of Practice (see below). However, many dive professionals are reluctant to spend the required funds and take the time to read through this Standard. Some diving operators argue that the diving medical examination requirements are overly conservative.

#### **AS2030.1: 1999 The verification, filling, inspection, testing and maintenance of cylinders for the storage and transport of compressed gases. Part 1: Cylinders for compressed gases other than acetylene** <sup>51</sup>.

This Standard specifies requirements for the verification, filling, handling, inspection, testing, and maintenance of refillable gas cylinders for the storage and transport of compressed gases, where the cylinders exceed 0.1 kg but do not exceed 3000 kg water capacity, other than acetylene cylinders, non-refillable cylinders and vacuum-insulated cylinders. It applies to the filling of scuba diving cylinders.

#### **AS3848.2: 1999 Filling of portable gas cylinders. Part 2 Filling of portable cylinders for SCUBA – safe procedures** <sup>52</sup>.

This Standard specifies procedures on safe practices for filling gas cylinders for self-contained underwater breathing apparatus (SCUBA) and non-underwater self-contained breathing apparatus (SCBA) where the breathing gas is compressed atmospheric air. Filling methods recommended are compressing of atmospheric air and decant filling of compressed atmospheric air. There are extremely high risks involved in the compressing or decanting of breathing gases and gas mixtures with more than 22% oxygen and these procedures are outside the scope of this Standard.

### **AS/NZS 4801: 2001 Occupational health and safety management systems – specifications and guidance for use** <sup>53</sup>.

This Standard specifies requirements for an occupational health and safety management system (OHSMS), to enable an organisation to formulate a policy and objectives taking into account legislative requirements and information about hazards or risks. It applies to those hazards or risks over which the organisation may exert control and over which it can be expected to have an influence. It does not state specific OHS performance outcomes.

This Standard is applicable to any organisation that wishes to—

- (a) implement, maintain and improve an OHSMS;
- (b) assure itself of its conformance with its stated OHS policy;
- (c) demonstrate such conformance to others;
- (d) seek certification/registration of its OHSMS by an external organisation; or
- (e) make a self-determination and declaration of conformance with the Standard.

All the requirements in the Standard are intended to be incorporated into any OHSMS. The extent of the application will depend on such factors as the OHS policy of the organisation, the nature of its activities and the conditions in which it operates.

Effective implementation of an OHS management system should seek to ensure the organisation complies with relevant OHS legislation, standards and codes of practice. However, the implementation of any of the requirements of this Standard, whether or not the organisation has gained certification from a third-party certification body or is otherwise recognised, does not in any way assure compliance with legal requirements, or other obligations placed upon the organisation by a statutory body. Hence, the implementation, either actual or intended, of this Standard, or parts thereof, would not preclude any action by a statutory body.

*Comment:* Much to the chagrin of many dive operators, dive businesses are classified as workplaces under OHS legislation and so this Standard applies for the protection of not only the staff, but also the customers who go diving with the operator. Prosecutions have been brought against some dive operators for failure to meet this Standard and /or Federal or State OHS Regulations.

### **HB211 Occupational health and safety management systems – a guide to AS4801 for small business** <sup>54</sup>.

Using examples and worksheets, gives guidance for small business to the requirements of AS 4801-2000 Occupational health and safety management systems - A specification with guidance for use.

Certain other Standards may also apply, for example, if the dive operator also operates a test facility for scuba cylinders. In this case AS 2473, AS 1349, AS 2337 and SAA MP48 will be relevant.

## **State and Territory Regulations**

In addition to Australian Standards, certain States have Regulations and/or Codes of Practice that directly apply to recreational diving. In addition, the Occupational Health and Safety Legislation in each State or Territory apply to diving in a workplace. Regulators have chosen to interpret the body of water where diving activities takes place as a workplace, occupied by employees (e.g. diving instructors) and non-employees who are nevertheless covered by the legislation on account of being “visitors in the workplace”.

## Queensland

The recreational diving and snorkelling industry is very large in Queensland, far more so than any other State, and the Codes of Practice were designed to increase safety and so protect the divers, the industry itself and tourism in Queensland.

In 1989, regulations relating to recreational diving and snorkelling in Queensland were created. These were Part 36 of the Workplace Health & Safety Regulations 1989 entitled "Dive shops, self-employed scuba instructors and dive charter vessels". These regulations were seen to be very arbitrary and prescriptive and created great concern in the dive industry. They were repealed in 1992 and replaced with the Code of Practice (COP) for Recreational Diving at a Workplace 1992. This COP was created after substantial consultation with, and input from, the dive industry representative body in Queensland. This COP was more extensive, more flexible, and applied differing standards to meet the needs of different diving groups.

Between 1992 and 1998 the COP was revised in reaction to several significant incidents and snorkelling was incorporated. The highly publicised disappearance of two divers on the Great Barrier Reef in 1998, among other accidents, precipitated a review of the legislation and then led, in 1999, to amendments to Part 12 Underwater Diving Work of Workplace Health and Safety Regulation 1997.

In 2000, the Compressed Air Recreational Diving and Recreational Snorkelling Code of Practice was released and was revised in 2005.

After a fatality involving a dive instructor using a mixed-gas rebreather, which was beyond the scope of the existing standards, a COP addressing technical diving was created and released. This was the Code of Practice for Recreational Technical Diving 2002<sup>55</sup>.

### **Compressed Air Recreational Diving and Recreational Snorkelling Code of Practice 2005. Queensland Government. Department of Employment and Industrial Relations<sup>56</sup>.**

This COP is far-reaching and requires operators to implement a variety of control systems to enhance safety of scuba divers and snorkellers.

*Comment:* This COP is certainly the broadest available in Australia and probably in the world. It is essentially self-standing, but does utilise the Diving Medical Standards in AS 4005: 2000.

Initially many of the dive operators in Queensland were very concerned about the COP. However, after recent revisions that were made in consultation with the industry, although some critics find it too restrictive in certain areas, it has become reasonably well-accepted as a fact of life there and the industry has generally adopted it effectively. There is a view that it has helped to 'weed out' some of the sub-standard dive operators and has generally enhanced the safety of diving in that State.

The Department of Workplace and Industrial Relations employs several dive inspectors to enforce the COP. These inspectors investigate on average 16 deaths every 2 years leading to only 1 or 2 prosecutions<sup>57</sup>. This indicates that most operators appear to be complying with the COP.

**Code of Practice for Recreational Technical Diving incorporating EANx diving, Mixed gas diving, Rebreather diving, Decompression diving (using air or other gases). Queensland Government. Department of Employment and Industrial Relations. Revised 2005. Queensland Government. Department of Employment and Industrial Relations <sup>58</sup>.**

The purpose of the *Recreational Technical Diving Code of Practice* is to give practical advice about ways to manage exposure to risks identified as typical when conducting recreational technical diving. This COP was initially introduced in 2001 and revised in 2005.

*Comment:* Technical diving involves breathing gases other than air, the possible use of rebreathers rather than scuba, and usually involves diving deeper and for extended bottom times. This form of diving can be associated with significantly increased risk and this COP was introduced to control such risk.

There is still relatively little technical diving conducted in Queensland, with only one further reported technical diving fatality. Therefore, there is little data available to determine how relevant or effective this COP has been. Some critics have argued that this COP has provided a disincentive for technical divers.

### **Western Australia**

**Diving and Snorkelling Codes of Practice. Recreational Diving using Compressed Gas and Recreational Snorkelling: 2003 <sup>59</sup>.**

Further to recommendations from a coroner investigating a 1998 dive fatality, a COP addressing recreational diving and snorkelling was prepared and released in 2003. Although this COP was released by the Department of Sport and Recreation, the regulatory function is provided by Worksafe WA. The COP is designed to facilitate compliance with the WA Occupational Health & Safety Act (1984).

This COP applies to all locations where recreational diving and snorkelling are likely to occur. All workplaces are covered by the Occupational Safety and Health Act (1984) and this document attempts to benchmark minimal acceptable standards for achieving compliance as well as best practice for the industry.

The Code provides information on the responsibilities of those involved in recreational diving and snorkelling in the workplace. It draws on a large range of Australian Standards: AS 4005, AS 1777, AS 1943, AS 2030, AS 2473, AS 2705, AS/NZS 2299, AS 1349, SAA MP48, AS 2337.

*Comment:* Although the intent of this document is good, the COP appears to have been hastily and relatively poorly prepared and contains a variety of inaccuracies and some questionable advice. It appears to have been largely ignored by the diving industry in WA, some viewing it as irrelevant. Others are not even aware of its existence. In addition, in WA the majority of recreational divers appear to dive independently of dive operators and so fall outside the scope of the COP. One concern expressed is that this COP refers to too many Standards and a dive operator is expected to pay around \$100 each to obtain these. It is very unlikely that many dive operators would have done so.

It also appears to be inconsistent that it is the Department of Sport and Recreation who created this COP, whereas it is Fisheries WA who licenses dive charter boats and the Department of Planning & Infrastructure who investigate dive accidents. This can inherently lead to inconsistencies in appropriate monitoring and management of the COP.

## Victoria

### **Code of Practice for Commercial Providers of Recreational Snorkelling & Scuba Diving Services in Victoria. June 2005. Dive Industry Victoria Association. (Voluntary COP) <sup>60</sup>.**

This COP is propagated by the local dive industry body to offer an opportunity for more effective self-regulation. The Scope states:

“This Code provides practical guidance to those persons providing recreational snorkelling and scuba diving services for reward in the State of Victoria.

The Code is designed to assist those persons in their management of the relative risks arising from providing such diving services in Victorian waters.

The Code is presented in a format acceptable to statutory bodies concerned with providing such diving services in Victoria and will facilitate operators in conducting their activities in an ongoing, self-regulated manner.

The object of the Code is to establish acceptable standards for making recreational diving in Victorian waters a pleasurable and rewarding activity for all concerned. This object can only be achieved when divers themselves recognise their own obligations to comply with standards for safe diving practices and with the directions of the operator and to accept ultimate responsibility for their personal safety.

This Code is to be read in conjunction with relevant legislation and Australian Standards A.S. 4005.1 2000 through A.S.4005.5 2000. Training and Certification of Recreational Divers and Australian Standard A.S.2299.3 2003 Occupational diving operation Recreational industry diving and snorkelling operations.”

*Comment:* It is interesting to note that in the scope it is made clear that this COP is designed to minimise the risks of dive operators and suggests that divers must “accept ultimate responsibility for their personal safety”. This is clearly different from the other COPs discussed earlier. There is always an interesting debate about where a dive operator’s responsibility ends and how much responsibility the individual diver should shoulder. This is an important and on-going debate, with no clear resolution currently in sight. (see NSW coroner’s comments below).

After a 1988 coronial enquiry into three local diving fatalities, the coroner made a series of recommendations to the dive industry in order to improve safety. She warned that unless the industry improved in certain areas, it may be appropriate to regulate the industry. Many of the recommendations were ignored and most of the industry continued to operate as it had before. A coroner investigating a death several years later echoed these concerns and prompted the industry to better self-regulate to avoid having regulations imposed upon it.

In 2000, some interested dive operators drafted a voluntary COP. In some areas it was quite unique as it specified different levels of training and experience required in order to dive different dive sites. This COP was largely ignored. It was revised in 2004, and again revised and released in 2005.

In late 2006, a coroner investigating two dive fatalities during training, again urged the industry to better self-regulate or risk having external regulation imposed.

Once again this COP had been largely ignored by substantial parts of the industry, many not being aware of its existence, much less its contents. However, following a recent high profile Worksafe Victoria prosecution of a well-established Victorian dive operator, and a subsequent industry audit by WorkSafe <sup>61</sup>, there has been a resurgence of interest in this COP and it is likely to be revised, and hopefully improved, in 2008.

## **Snorkelling, SCUBA Diving and Wildlife Swims. Adventure Activity Standards (AAS): April 2005. Outdoor Recreation Centre Inc <sup>62</sup>.**

The AAS are voluntary guidelines for undertaking potentially risky activities in a manner designed to promote safety for both participants and providers, protection for providers against legal liability claims and criminal penalties, and assistance in obtaining insurance cover. These are not statutory Standards imposed by law.

*Comment:* For scuba diving these Standards reference AS 4005, AS 2299.3:2003 and the DIVA COP as appropriate Standards for scuba diving training and conduct of dives and do not add more. However, they do provide some additional suggestions for the conduct of snorkelling. In Victoria, the AAS have been adopted by many schools as a basis for snorkelling activities either provided directly by the school, or by a contracted provider.

In addition to Victoria, AAS Guidelines currently exist for SA, Tasmania and WA but these will not be discussed. The Victorian AAS guidelines are only mentioned here as they are referred to in the local COP addressed.

### **New South Wales**

There are no regulations or COP specific to diving in this State. This was investigated following a coronial enquiry in 2002 but rejected.

In 2002, after investigating two dive fatalities, a NSW coroner issued a series of recommendations regarding regulation of the dive industry in that State. He was very critical of self regulation by the diving industry and of the main diver training agency (PADI). He stated in part: "... To my mind, it is no answer to say that this is an adventure sport that the participant is qualified to take the risk, that if they don't know what to do, they shouldn't be there in the first place, and that in such a sport deaths are going to occur from time to time. The young people I am concerned with in these inquests comprise some of the industry's most vulnerable participants <sup>63</sup>.

### **South Australia**

There are no regulations or COP specific to diving in this State.

### **Tasmania**

There are no regulations or COP specific to diving in this State.

### **Northern Territory**

There are no regulations or COP specific to diving in this Territory.

### **ACT**

There are no regulations or COP specific to diving in this Territory.

## **Occupational Health and Safety Regulations**

As mentioned earlier, in addition to other Regulations and/or COPs that may exist in various States, each State and Territory have Occupational Health and Safety Regulations that can apply to any diving involving employees and/or a workplace.

In Queensland to date, 18 prosecutions have occurred over the years for breaches of its Occupational Health & Safety Regulations that occurred in a recreational diving workplace <sup>57</sup>.

In Victoria in 2007, much of the Victorian dive industry was shocked when one operator was fined a record \$200,000 for a breach of various OHS regulations that allegedly contributed to the death of an

inexperienced diver. This then led to Worksafe Victoria conducting an audit of all identified commercial recreational dive operators.

In response to this prosecution and audit and working together with the industry, the Divers Alert Network (DAN) initiated and part-funded (together with an equipment distributor, a training agency and the local dive industry body) the production of a Dive Operators' Manual to assist dive operators with the awareness of, understanding and compliance with the various standards, regulations and the COP pertinent to their businesses. This manual has been produced, free of copyright, and it is hope that it can serve as a template for the creation of similar manuals in other parts of Australia, and beyond.

In addition to the above, dive operators are required to comply with various State and Territory Marine Regulations, as displayed in Table 3.

#### **Monitoring Compliance with a regulatory Code of Practice**

There appears to be little doubt that the existence of the regulated Codes of Practice in Queensland has improved scuba diving and snorkelling safety in that State. However, there is a substantial cost associated with the monitoring and enforcement of compliance with these Codes. Queensland has a long coastline with commercial recreational diving operators based in a variety of areas, distant from each other. Because of this, and the large number and size of dive operators in Queensland, there are at least three full-time diving inspectors dedicated to this task.

The dive industry in Queensland is far larger than in the other States and Territories and represents many millions of tourist dollars to that State, from both international and domestic visitors. Dive tourism is relatively small in most other States and Territories, although it appears to be growing in WA, especially on the northern coast.

The costs of promulgating and the monitoring of a Code of Practice for diving may well be prohibitive in most States and Territories.

The introduction of the regulated COP in Queensland was partly an attempt to increase the confidence of many domestic and international tourists of the relative safety of diving in Queensland. However, there has been a reaction from some small parts of the dive community who find that certain requirements restrict their freedom to dive how they wish. Some international tourists have complained that they have come to the Great Barrier Reef to dive and have been unable to do so due to higher medical standards being applied to diving here. Some have required a local medical clearance prior to the dive operator allowing them to dive, and this is not always appreciated!

## Surveying industry views on diving safety

As part of this investigation into diving safety, a small survey was sent to a selected group of key organisations and individuals, who have had extensive involvement in the recreational diving industry in Australia, in order to canvas their views. In some cases this was followed up with a telephone interview to further discuss the issues. The group selected was chosen to represent each Australian State and Territory. Included were representatives of the main diver certification agencies, diving operators, diving physicians, diving inspectors as well as some independent and highly experienced diving educators.

Fourteen responses were received and these included: certification agencies, diving physicians, dive operators, dive instructors/educators, and dive inspectors.

The survey consisted of the following questions:

1. Please briefly outline any issues, if any, that you believe are compromising recreational diving safety in your State safety and/or in Australia as a whole at this time?
2. If there is a Code of Practice (COP) for recreational diving in your State (regulatory or voluntary), how do you believe that this has impacted on diving safety? Please describe any positive and negative effects of such a COP.
3. In your view, do the Australian Standards 4005 represent satisfactory standards for recreational diver and dive professional instruction in Australia? If not, please state your concerns.
4. Do you believe that the current system of diving medical examination requirements are suitable for:
  - a. Recreational divers
  - b. Divemasters and instructors

If not, please state your concerns.

5. What suggestions do you have, if any, for improving recreational diving safety in Australia into the future?

The responses are shown in Appendix A and were taken into consideration when preparing recommendations in this report.

## Summary

- Scuba diving is an adventure sport participated in regularly by an estimated 80,000 Australian residents, and with possibly in excess of 200,000 foreign visitors diving whilst in Australia. There are approximately 50,000 new scuba divers trained in Australia annually. In addition to this, it is likely that in excess of 2 million snorkel dives are conducted annually around the Australian coastline.
- As diving is conducted in a potentially hostile environment it has inherent risks. It is essential that participants are made appropriately aware of these risks prior to participation.
- Risks are associated with inadequate training, unfamiliarity with the diving environment, changing environmental conditions, unfamiliarity with equipment, equipment failure, inadequate physical, medical or psychological fitness, human error, violations of safety rules and inadequate supervision of inexperienced divers, among others.
- Many of the risks can be reduced by factors such as adequate education and training, ensuring 'fitness' for diving, appropriate supervision, appropriate and functional equipment, and common sense.
- There needs to be an appropriate balance within the dive industry between risk awareness and acceptance by the divers themselves, and level of supervisory responsibility of dive operators. Although dive operators have a Duty of Care, participants in these activities must be willing to accept responsibility for a reasonable level of risk. The appropriate level should change with the level of training and experience, with progressively greater responsibility being taken by divers with high levels of training and/or relevant experience. An area of uncertainty currently exists about the status of charter boat operators who claim to merely provide transport by private divers to their chosen dive site.
- The number of deaths of scuba divers and snorkellers has increased significantly over the past 30 years, almost doubling since the 1980's. This is likely to be largely a result of increased diving activity; the involvement of participants who have less aquatic experience; and the involvement of participants who are older and less medically and physically fit. It has been speculated that this could also be due in part to a reduction in certain diver training standards, although there is no evidence of this relationship.
- An increased mortality from the ageing diver population is a trend that currently needs to be addressed, possibly through better education of divers and dive professionals, and an appropriate diver health monitoring system.
- There are concerns about fatalities involving inexperienced divers diving in unfamiliar conditions and divers who haven't dived for extended periods that need to be addressed, as does the increasing accident rate in deep, technical divers.
- The high accident rate in WA and Tasmania in untrained divers who are obtaining and using hookah/SSBA for underwater fishing needs to be addressed.
- The mortality rate of scuba divers in Australia can be estimated to be 0.57/100,000 dives. However, it remains difficult to obtain a reliable estimate of the actual number of dives performed in Australia annually. If this estimate of 0.57/100,000 is reliable, it would compare favourably with reported scuba diver mortality rates in other countries.
- The rate of decompression illness (DCI) in divers in Australia can be estimated to be 10.74/100,000 dives, which again appears to compare favourably internationally.

- There are a variety of Standards, Regulations and/or Codes of Practice that apply to recreational diving and snorkelling activities in Australia. These include:
  - International: ISO standards for the training of recreational scuba divers  
Voluntary international dive training standards propagated by training agencies
  - National: A variety of Australian Standards
  - State/Territory: OH&S regulations in each State or Territory
    - COPs in Queensland for recreational diving & snorkelling and for technical diving supported by OH&S Regulations
    - Code of Practice in WA propagated by WA Dept of Sport & Recreation
    - Voluntary dive industry COP in Victoria
- It appears that the regulated COPs in Queensland have improved diving safety in that State. However, there is a substantial cost associated with monitoring compliance these COPs. Such costs may be prohibitive to the introduction of regulated Codes of Practice in other States/Territories where the diving industries are far smaller.

## Discussion

Diving has inherent risks and scuba divers and snorkellers must accept a certain degree of responsibility for their own safety. However, dive operators have a Duty of Care to provide their services with a reasonable degree of safety and professionalism.

The diving industry in Australia is predominantly a commercial industry which, like most other industries, strives to minimise its costs in order to maximise its profits. There is a constant balance between these commercial imperatives and the safety of the diver clients. Some critics have argued that certain decisions that are made regarding training and operational standards may sometimes compromise safety. To this end, the existence of an external mediator in the form of, possibly, an appropriately monitored Code of Practice may be beneficial for safety.

However, although the diving industry in Queensland is large and reasonably robust, by contrast in places such as Victoria, Tasmania, South Australia and the Northern Territory it is very small and many operators find it difficult to remain viable from time to time. The imposition of unrealistic and impractical requirements could further undermine the viability of the industry in these areas. Any specific regulations affecting the dive industry should only be introduced after extensive consultation and reasonable support from various parts of the industry. Otherwise they are less likely to be effective.

The dive community in Australia is part of an international dive community. Divers, and dive professionals (i.e. divemasters and instructors) from other countries travel here from time to time, especially to the Great Barrier Reef, to dive or to work in the industry, training or guiding divers. For this reason, we must aim to be sensitive to international standards and, where they are reasonable, consider adopting these. As indicated earlier, there are international training standards from ISO and RSTC. The ISO standards appear to be generally higher and have broader input than those from the RSTC. However, they still represent a considerably lower standard in some practical and medical aspects than those currently reflected in AS 4005. There is some concern that a further erosion of training standards (including medical assessment standards) in Australia could precipitate an increase in morbidity and mortality.

There are no international standards for the conduct of dive operations and there is a current need for clear, practical and accessible guidelines to protect recreational divers and snorkellers and to assist dive operators with the safe delivery of their services. Although AS 2299.3 addresses this issue locally, it is not widely circulated among diving operators and, by the nature of how the Standard is presented, can appear confusing to many operators. A more clearly written National Code of Practice, based on AS 2299.3, may be easier to understand and, therefore, to implement by diving operators. The previous experience in Victoria and Queensland suggests that an industry monitored COP may not be as effective as one that is externally monitored, but which has reasonably industry consultation and support.

## Recommendations to Improve the Safety of Snorkelling and Scuba Diving in Australia

Although it appears that Australia has a relatively good track record for diving safety, there are a number of measures that could possibly be implemented to improve the safety further. Such measures should only be considered after appropriate consultation and discussion and with support of the industry. These may include:

- Maintain existing Australian Standards for the training of recreational scuba divers and dive professionals, rather than adopt the less stringent ISO or RSTC Standards.
- Investigate various means of improving awareness of and compliance with AS/NZS 2299.3, the Standard for the conduct of recreational diving activities involving an occupational component.
- Should the above be achieved through the introduction of a National Code of Practice for the conduct of safe recreational diving operations, it should cover organised recreational and educational groups, even if not technically classified as occupational. It should also specifically address snorkelling activities.
- Should the government of any State or Territory recognise the need to operate at a higher standard, then the National Code of Practice could be strengthened or resources provided to monitor or enforce compliance on similar lines to the approach taken in Queensland.
- Regulate to restrict the purchase of diving equipment which carries identified risks over and above those associated with normal recreational scuba equipment to those who have evidence of appropriate training. Currently, this is predominantly Surface Supplied Breathing Apparatus (SSBA – Hookah) and rebreathers.
- Provide support for programs designed to educate divers about the importance of maintaining diving health and fitness and the need for appropriate periodic diving medical re-assessment.
- Provide support for the establishment of an appropriate “Diver Health Registry” through which divers can conduct self-assessments and can be referred to diving medical expertise as required.
- Provide support for on-going research and monitoring of diving safety.
- Support and enhance appropriate measures to increase the availability of technology that could improve diver safety (e.g. diver location and emergency call devices). This may include industry support for development of new dive safety technology or the removal of barriers to the import of appropriate technology.

## **Contributors**

This issues paper was developed by John Lippmann OAM of the Divers Alert Network and Royal Life Saving Society Australia. During the process of writing this issues paper, the author engaged with a number of people working in the diving industry or with diving safety from all over Australia. The author would like to thank all people who gave their time, information and opinions freely. Their contributions were invaluable and it is hoped that they will benefit from this paper.

## **Acknowledgments**

This issues paper was undertaken as part of a project funded by the Commonwealth Department of Health and Ageing.

## **Suggested Citation**

Lippmann J (2008) Issues Paper. Recreational Scuba Diving and Snorkelling Safety in Australia: An identification, summary and analysis of policies, legislation and standards relevant to recreational scuba diving and snorkelling. Royal Life Saving Society Australia: Sydney

## Glossary

AAS	Adventure Activity Standards
ACT	Australian Capital Territory
AED	Automated External Defibrillator
AS	Australian Standard
AWSC	Australian Water Safety Council
Breath Hold Diving	Involves swimming on the surface using mask and snorkel (and usually fins) and underwater swimming while holding one's breath.
COP	Codes of Practice
CPR	Cardio Pulmonary Resuscitation
DAN	Divers Alert Network
DCI	Decompression Illness
DECOMPRESSION ILLNESS	DCI is a general term that includes decompression sickness and arterial gas embolism. Decompression sickness can occur during or after ascent from a dive using compressed gas as a result of excess inert gas forming bubbles in the blood or body tissues. Arterial gas embolism can occur when air bubbles enter the arterial circulation as a result of pulmonary barotrauma (burst lung).
ERAS	Exercise, Recreation and Sport
Hookah	Common name for Surface Supplied Breathing Apparatus
ISO	International Standards Organisation
NSW	New South Wales
NT	Northern Territory
NWSP	National Water Safety Plan
OHS	Occupational Health and Safety
OHSMS	Occupational Health and Safety Management System
Qld	Queensland
Rebreather	Underwater breathing device designed to enable the diver to re-breathe expired gas by the extraction of carbon dioxide and the addition of supplemental oxygen.
RLSSA	Royal Life Saving Society Australia
RSTC	Recreational Scuba Training Council
SA	South Australia
SCBA	Self Contained Breathing Apparatus

SCUBA	Self Contained Underwater Breathing Apparatus
SPUMS	South Pacific Underwater Medical Society
SSBA	Surface Supplied Breathing Apparatus
Tas	Tasmania
Technical Diving	Recreational diving using breathing gases other than air and/or diving that requires mandatory decompression stops. This often requires equipment additional to that carried for normal recreational diving.
UK	United Kingdom
Vic	Victoria
WA	Western Australia

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## Appendix A: Surveying Industry Views on Diving Safety

As part of this investigation into diving safety, a small survey was sent to a selected group of key organisations and individuals, who have had extensive involvement in the recreational diving industry in Australia, in order to canvas their views. In some cases this was followed up with a telephone interview to further discuss the issues. The group selected was chosen to represent each Australian State or Territory. Included were representatives of the main diver certification agencies, diving operators, diving physicians, diving inspectors as well as some independent and highly experienced diving educators.

Fourteen responses were received and these included: certification agencies, diving physicians, dive operators, dive instructors/educators, and dive inspectors.

The respondents were:	G. Dive operator	M. Dive inspector
A. Certification agency	H. Dive operator	N. Dive inspector
B. Certification agency	I. Dive operator	O. Dive instructor/educator
C. Certification agency	J. Dive operator	
D. Certification agency	K. Dive Instructor/educator	
E. Dive physician		
F. Dive physician	L. Dive operator	

The survey consisted of the following questions:

1. Please briefly outline any issues, if any, that you believe are compromising recreational diving safety in your State safety and/or in Australia as a whole at this time?
2. If there is a Code of Practice (COP) for recreational diving in your State (regulatory or voluntary), how do you believe that this has impacted on diving safety? Please describe any positive and negative effects of such a COP.
3. In your view, do the Australian Standards 4005 represent satisfactory standards for recreational diver and dive professional instruction in Australia? If not, please state your concerns.
4. Do you believe that the current system of diving medical examination requirements are suitable for:
  - a. Recreational divers
  - b. Divemasters and instructorsIf not, please state your concerns.
5. What suggestions do you have, if any, for improving recreational diving safety in Australia into the future?

## Responses

The responses to the survey have been listed below. It is obvious that there is a variety of different perspectives and in some cases divergent views, as can be expected from the diverse group surveyed.

*Question 1: Please briefly outline any issues, if any, that you believe are compromising recreational diving safety in your State safety and/or in Australia as a whole at this time?*

## **Training & compliance**

- There needs to be greater compliance to training standards and local regulations (A, C, F,O)
- Better monitoring of instructor conduct by the training agencies (C,O)
- In WA, prospective divers can obtain a licence to dive for crayfish without producing evidence of any diving qualification. This has reportedly resulted in significant morbidity and mortality (H)
- Some respondents argued that initial diver certification should include more open water diving time than is often provided and that prospective instructors should be required to have more experience than is currently required (K, N,O)
- Concern was expressed that it is common for divers to leave entry level training without the skills to safely conduct dives in different conditions. (M, N,O)
- There is no doubt that the level of training of divers and dive professionals in Australia has lowered considerably over the years. However, this doesn't appear to have led to a large increase in dive accidents so maybe the current standards are adequate. (D)
- One respondent expressed concern that some operators are certifying open water divers without conducting boat dives to the depths specified in the standards. (J)
- It has been suggested that there is sometimes insufficient verification and categorisation of new divers when hiring gear or booking dives. (J,O)

## **Conduct of the dive**

- The divers and dive professionals need to be constantly reminded of the need for a proper dive brief, adequate buoyancy checks and maintenance of buoyancy and equalisation skills, avoiding buddy separation, regular monitoring of depth and air supply (A)
- Divers and dive operators ensuring that the divers are adequately trained and/or experienced for the dive site and the prevailing conditions (C,H,F,N,O,A,M)

## **Diver Health**

- Divers need to monitor physical and psychological health and consult an appropriate physician if there is any deterioration (E,M,F)
- Increasing issues involving older divers and cardiac-related death while diving (M,B,E,O)

## **Infrequent divers**

- Diving skills and knowledge deteriorate without regular exposure and there is a need for infrequent divers to do a refresher dive(s) in non-challenging conditions after an extended period without diving (C,M,O)

## **Equipment and breathing gas**

- Ensuring divers are adequately trained and experienced for the equipment they are using. (C,J,H,E,F,O)

- Ensuring appropriate breathing gases are used. (C)
- Ensuring that equipment is properly serviced and functional. (C)
- Ensuring that equipment sellers clearly explain the features and potential impact of new equipment to purchasers and any changes in dive practice required to use the equipment safely. (E)
- Ready access to Surface Supplied Breathing Apparatus (SSBA or Hookah) for untrained persons leading to a relatively high incidence of DCI and death in some areas (e.g. Tasmania and WA). (F,H)
- Unregulated access to dive equipment via the internet may enable unqualified divers to buy equipment. (J)

### General

- Lack of well-trained multi-lingual instructors in areas with large overseas tourist divers. (B)
- Low pay rates for instructors in some parts of the industry attracting poorer quality and less experienced dive professional and contributing to a high turnover rate. (B)
- One large operator in Qld expressed concern about being restricted to employing Australian or those with limited work permits. He claimed that there are better qualified/motivated individuals available on temporary work permits or offshore that he is unable to employ. (G)

*Question 2: If there is a Code of Practice (COP) for recreational diving in your State (regulatory or voluntary), how do you believe that this has impacted on diving safety? Please describe any positive and negative effects of such a COP.*

Qld responses:

- Generally appears to be a tighter safety regime since the introduction of the COP. The improved lookout system does save lives. A negative impact is the increased workload for the crew which can lead to higher staff turnover with a possible impact of safety. (G)
- The introduction of the COP has increased safety within the industry. Standards alone have limited value without support and enforcement. Such a COP must be developed with extensive industry consultation and support and advisory and educational resources need to be made available to the industry. Regular visits from inspectors with real industry knowledge required, as is sufficient ability for enforcement. (M)
- There is no doubt that the COP and its enforcement have resulted in a safer workplace and dive industry. The negative side is the cost of compliance. The COP requires more staff, training and administrative effort by dive operators leaving less time in which to build their businesses. (B)

WA responses:

- The COP was hastily written with little consultation and never embraced by the dive industry. Thankfully the COP is largely forgotten. (H,I)

- The COP can be over-restrictive and if a dive operator followed all its requirements, divers may be discouraged to dive with them and may decide to dive independently. This would likely be detrimental to safety. (H)
- The COP is irrelevant to the industry here and is ignored. There should be a few obstacles to the dive operator as possible so that they can expand their businesses. Diving in Australia is relatively safe and is already over-regulated. (I)

Vic responses:

- Until recently many operators were unaware of the existence of the COP. Others probably never read it. It is a pretty amateur document and needs more work. I also question the usefulness of a voluntary COP. There needs to be some kind of penalty for serious or consistent breaches by an operator. (D)
- The existence of an appropriate COP should assist with dive safety. The only negative impact of having a COP is that it sets a standard that some operators might not be comfortable with and it does expose those who are either not operating at the appropriate level or who have an unfortunate accident to a measuring stick that can be used in legal or enforcement matters, which may in fact not be a bad thing. The existence of a COP can be used as a positive marketing tool by the industry. (J)

*Question 3: In your view, do the Australian Standards 4005 represent satisfactory standards for recreational diver and dive professional instruction in Australia? If not, please state your concerns.*

- No. These Standards are not reflective of the accepted international standards. The training standards should be in accordance with ISO. (C)
- No. We should be using the RSTC standards and taking a global view. (B)
- 4005 are satisfactory standards for the training of divers and outline appropriate medical standards at entry to diving. (F)
- I believe that 4005 is a good set of standards. (N)
- I believe that the 4005 standards have insufficient dive time for the trainee diver and prerequisite dives for the instructor. (K,O)
- As the AS 4005 series closely identifies the training requirements of major recreational scuba training agencies that operate in Australia, it is our view that it has less relevance to dive safety in Australia. (A)
- The 4005 series probably creates less of a concern for operators than 2299.3. Most incidents are associated with the conduct of diving, rather than specifically the training standards covered in 4005. Both sets of standard need revision as 2299.3 is based heavily on the Qld COP which have been revised and the 4005 doesn't address resort diving and advanced and rescue diver training. (M)

*Question 4: Do you believe that the current system of diving medical examination requirements are suitable for:*

*a. Recreational divers*

*b. Divemasters and instructors. If not, please state your concerns.*

- Recreational divers – Safe, yes but perhaps too strict. Divemasters and instructors – yes. (G)
- We are often bending and twisting the medical requirements in AS 4005 for divers because we now believe that people can dive with a variety of medical conditions previously considered to warrant exclusion. The requirements need to be re-written and be evidence-based, although there is relatively little available evidence. There are fewer issues applying 2299 medical guidelines to dive professionals. (E)
- The entry level screening tool in 4005 is suitable but there should be a mechanism for the tool to be reviewed regularly and updated to represent current knowledge. In addition, it would be beneficial if there was a suitable tool to assess the medical fitness of divers on the day of diving as their healthy may well have changed since the entry dive medical was performed. For dive workers, the current 2299 system is onerous with the requirement for an annual dive medical. There could be a scale for regularity of medicals, dependent on age. (H)
- We hold the view that the RSTC Medical Declaration is sufficient for recreational diver training. We agree that a medical should be required for leadership level and instructor certification but do not agree that this should be required annually, unless the medical condition of the person changes to an extent that a medical is necessary to return to work after a serious illness or injury. (A)
- The medical examinations required by professional divers should be annual and as per 2299. Recreational divers should also have an entry-level medical as per 4005, and I suggest an annual medical would not be inappropriate. (N)
- 4005 are satisfactory standards for the training of divers and outline appropriate medical standards at entry to diving.

There does appear to be a trend towards medical assessment by questionnaire only, administered by the training organisation. This also applies to children < 14 years who are being targeted for entry level courses. Because SPUMS requires divers to be 14 years or over, there is a loophole that is of concern.

There is also a problem with ongoing health and fitness monitoring in recreational divers. Once the entry medical is completed, there is no ongoing requirement for health checks, and it is in effect a “lifetime fitness certificate”. This could be improved by making the fitness statement conditional upon ongoing good health and if any conditions develop in the future, the diver must seek medical advice as to the impact of the health problem on their diving.

The other area missing from the dive medical is some form of assessment of aerobic fitness and swimming capability. It would be great if there could be better information transfer between the instructor (assessing practical competence and observing aptitude in the water), and the doctor – particularly if prospective students are marginal with skills or fitness.

The recreational series of standards for dive masters and instructors mainly covers training. The medical fitness aspects refer to AS 2299.1. It is my personal observation that instructors and dive masters do not maintain annual medical fitness examinations. How they and the training organisations get around this is a mystery. A recreational code of practice and state legislation would assist this. (F)

- Mandatory medicals have not been proven to result in a safer entry-level student and should be dropped. An AS 2299 medical for dive professionals is appropriate. (B)
- There is no need for a medical for all entry-level divers. Should allow for a self-declaration for students and request a medical if any concerns are indicated. For dive professionals the medical in 4005 is adequate and 2299.3 should not be required. (C)
- The medical requirements for entry-level divers are too stringent and may prevent many divers from taking additional training as a new medical if required before another course if more than a year has expired since the examination. The initial medical may be a good idea but should be valid for longer than a year. Medical advice should be sort if the divers condition changes. The medical needs to be able to be done by any doctor as it will be easier for divers to get them done and more will then be trained, rather than diving without being trained as is often the case in WA. The situation with dive professionals in WA is acceptable. (H)
- For divers, there needs to be better coverage in the medical where it is apparent that the diver had some fitness concern, obesity or general lack of fitness for the sport. I am comfortable with the medical standards for dive professionals. (J)
- The diving medical requirements are fine both for recreational as well as for Divemasters and instructors as long as the dive shops adhere to those requirements. (L)

*What suggestions do you have, if any, for improving recreational diving safety in Australia into the future?*

- Better awareness of, and application of, uniform standards throughout the industry. (C,J)
- More safety education during training for divers (eg. CPR at entry-level) (J)
- Better control of divers who purchase equipment , hire equipment, book on dives or obtain diving licences (J,E,H)
- Require instructors to complete a reassessment to maintain currency (C,O)
- Make any COPs practical, effective but not overly restrictive. (O)
- Prosecute those whose negligence causes a fatality. (H)
- Create better strategies to prevent and manage the emerging problem of heart attacks while diving including increasing the availability of AEDs on appropriate vessels. (B)
- It would be helpful to incorporate into any State-based legislation/COP a central registry of diver health. This would assist in collecting better data on dive accidents and medical issues. (F)
- Increase the length of the entry-level dive course to better equip divers to dive in less than ideal conditions. This may well reduce the high drop-out rate from the sport. (K,O)
- Continue to monitor training practices to ensure that they meet training standards and local regulations/COP. (A)
- Provide on-going education for employees to ensure skill and knowledge maintenance. (A)
- Educate dive professionals in risk management and regulatory requirements. (A)
- Monitor diving incidents and address any apparent trends. (A)

- Communicate with regulatory bodies. (A)
- Create a national employers organisation, supported by state-based structures to provide a strong, representative voice on the development of standards and to provide feedback to government on behalf of its membership. (M)
- The government should develop positions within their OHS structure for credible inspectors to undertake educational, advisory, assessment and enforcement activities. Develop nationally consistent standards and call these up in State-based legislation. (M)
- Divers need to review their health status as they age and a single dive medical at the start of their diving is inappropriate. This could possibly be done using a simple questionnaire that divers could review themselves annually and be advised to contact a doctor if necessary. (E,O)
- Emergency response and evacuation systems could be expanded in some areas. (G)

## Appendix B: Divers Alert Network (DAN)



The Divers Alert Network Asia-Pacific (DAN AP) a not-for-profit, membership-supported diving safety, medical and research organisation dedicated to enhancing the safety and health of recreational scuba divers within Australia and elsewhere in the Asia-Pacific Region. It is part of the International Divers Alert Network (IDAN) which includes branches in the USA, Europe, Africa and Japan. These branches are all non-profit and independent, but operate under a similar charter. DAN was founded in 1980 at Duke University in North Carolina, USA. DAN Asia-Pacific, based in Melbourne, Australia, has been operating since 1994.

DAN serves as a lifeline for the scuba industry by operating and supporting a network of 24-hour emergency hotlines, a lifesaving service for injured divers. Additionally, DAN operates diving medical information lines, conducts vital diving medical research, and develops and provides a number of accident management educational programs for everyone from the general community, beginner divers to medical professionals. It also acts as an advocate for divers on diving safety.

DAN's historical and primary function is to provide emergency medical advice and assistance for underwater diving injuries, to work to prevent injuries and to promote diving safety. Second, DAN promotes and supports underwater diving research and education particularly as it relates to the improvement of diving safety, medical treatment and first aid. Third, DAN strives to provide the most accurate, up-to-date and unbiased information on issues of common concern to the diving public, primarily, but not exclusively, for diving safety.

DAN is funded mainly by membership subscriptions. DAN Asia-Pacific has just over 6,000 members, out of a total of around 270,000 DAN Members worldwide. DAN members are automatically covered for emergency medical evacuation worldwide and receive a subscription to Alert Diver, diving's only dedicated health and safety magazine. Members also have access to dive injury treatment insurance, priority access to non-emergency diving medical advice, among other benefits.

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