QUEENSLAND COURTS

OFFICE OF THE STATE CORONER

FINDING OF INQUEST

CITATION:	**Inquest into the death of – Amanda Helen BOYCE**
TITLE OF COURT:	Coroner's Court
JURISDICTION:	Brisbane
FILE NO(s):	COR 0651/06(1)
DELIVERED ON:	Monday 18 December 2006
DELIVERED AT:	Brisbane
HEARING DATE(s):	11 September 2006 and 12 September 2006
FINDINGS OF:	Mr Ray Rinaudo, Acting Deputy State Coroner
CATCHWORDS:	**CORONERS: Inquest, death in spa, Reynolds equation, laminae flow, turbulent flow, hair entrapment, tangling and knotting.**

REPRESENTATION:

Counsel Assisting:	**Mr Bradley W. Farr** Barrister-at-Law
Mr and Mrs Boyce: Parents of the deceased	**Ms Penny Feil**
Seahaven Resort	**Mr Gareth Beacham** Barrister-at-Law Instructed by: **Sykes Pearson Miller, Solicitors.**
Mr Barry Mulligan and Mr Dave Robbie	**Mr Craig Eberhardt** Barrister-at-Law Instructed by: **Tebbett & Oswald, Solicitors.**

Hearing

Two days of evidence were held on 11 and 12 September 2006.

The following **witnesses** gave evidence:-

Day One:

Senior Constable Vanessa Jane Walker – Investigating Police officer.
Adrienne Elizabeth Reinke – Friend of the deceased.
Dr Jonathon Lee Stellmach – medical practitioner who assisted at the scene.
Mr Mark Eric Jacobs – Lifeguard who assisted at the scene.
Mr Hamish James Ferguson Hill – witnesses who assisted at the scene.
Mr Trevor John Mill – Retired, former manager of Seahaven Resort, who rendered assistance on the day.
Mr Scott William Trim (formerly Metcalfe) – a witness who rendered assistance at the scene.
Mr Kenneth John Moss – a former lifeguard who rendered assistance at the scene.
Mr George Mitris – a witness who rendered assistance at the scene.

Day Two:

Mr Mark Chandler – Principal Investigator, Workplace Health and Safety
Mr Barry Walter Mulligan – Director of Billabong Proprietary Limited.
(Mr Mulligan, made a claim of privilege on the grounds of self incrimination. The application was not overruled and the witness was directed to answer questions put to him.
Mr Peter Cameron Goodridge – maintenance supervisor at Seahaven Resort.
Mr Thomas Anthony Edmund Heron – Senior principal advisor in the technology unit of the Division of Workplace Health and Safety.
Mr Craig Alan Hutton – Chief Safety Emgineer, Workplace Health and Safety.
Mr Clay Warner Anderson – employee of Noosa Council.

The following witness was called, but after a claim of privilege by his counsel, which was allowed, he was excused without answering any questions:

Mr David Neil Robbie – a person responsible for pool cleaning service and maintenance.

All occupations are noted as at the time of the incident.

A number of **exhibits** were admitted into evidence marked A1 to B20.

This comprised exhibits1 to 56 as per the list prepared and contained in two volumes.

The respective parties were represented as set out above. The counsel for Mr Mulligan and Mr Robbie only appeared on the day two.

The Act

As this death occurred on the relevant law applicable at the time was the Coroners Act 1958. The provisions of this act are different to the current Act (The coroners act 2003 which came into force on 1 December 2003 in material ways. There is no power to direct witnesses to answer questions and it is the coroners responsibility to determine if any person or entity has been criminally responsible for the death and should stand trial.

INTRODUCTION

On the 10 December 2001 the deceased child was on holidays with friends at Seahaven Resort, Hastings Street, Noosa heads. She was staying with the family of her friend Adrienne Elizabeth Reinke.

Mr Mark Chandler, Principal Inspector from the Investigations unit at Nambour provided a report dated 12 December 2002. He gave a succinct summary of the relevant facts which is reproduced here:-

2.1 On 9 December 2001, Ms Pamela Ann Reinke, checked into the Seahaven Resort, for a week-long holiday. Her two children, Adrienne (aged 14) and Sam, and her niece Sarah (Aged 9) accompanied Mrs Reinke. Also present was a school friend of Adrienne, Amanda Helen Boyce (aged 13). Miss Boyce had accompanied the family on their holiday and as such was under the temporary care of Mrs Reinke.

2.2 At approximately 1.30 p.m. on 10 December 2001, Adrienne, Sarah and Amanda were given permission by Mrs Reinke to use the spa. Mrs Reinke remained in the hotel room with her son Sam.

2.3 According to Adrienne Reinke, when the girls arrived at the spa it was not operating. She knew this because no bubbles were coming out from the jets. Adrienne was aware that the spa could not be operated before 3 p.m. daily as she and the other children had visited the pool/spa area earlier that same day. During the previous visit to the pool, the girls were timing themselves to see how long they could remain underwater in the swimming pool.

2.4 When the girls entered the spa in the afternoon, they placed their head underwater to wet their hair. Miss Boyce had particularly long hair (down to her waist) that was not tied back. When Miss Boyce placed her head underwater the second time, she slid off the submerged seat inside the spa and sank to the bottom. She did not return to the surface. After a short while, Adrienne became concerned and attempted to find Miss Boyce's legs to pull her to the surface. Adrienne has stated that Miss Boyce was not struggling or moving at this time.

2.5 Adrienne continued to attempt to pull Miss Boyce to the surface, she then realised that Miss Boyce's hair had become caught in the pipes located at the base of the spa.

2.6 The girls called immediately for help. It is unclear who arrived at the spa first, it is probable that more than one person arrived simultaneously. In any event, one of the first persons to arrive was Dr Stellmach. According to Dr Stellmach, he was in holidays at the Resort and was sitting on his balcony when he heard a young girl scream. He then ran down the spa and "noticed another man running around…calling for a knife or scissors". Dr Stellmach jumped into the spa and noticed a young girl trapped underwater by the hair. She was lying on her back face up. Her head was well below the surface of the water – "It may have been a metre below".

2.7 Dr Stellmach entered the spa and attempted to free Miss Boyce. Unfortunately she could not be moved. Dr Stellmach tried to give Miss Boyce mouth to mouth resuscitation while underwater, however this was "unsuccessful as her lungs were already full of water and she seemed unconscious". Another male entered the spa (George Mitris) and attempted to free Miss Boyce. Mr Mitris estimates that it took between 3 to 5 minutes to free Miss Boyce. Mr Mitris estimates that it took 3 to 5 minutes to free Miss Boyce. While Dr Stellmach and Mr Mitris worked, another male, Mr Hamish Hill, was supporting Miss Boyce's legs and lower body. By this time, other members of the public gathered nearby.

2.8 It is uncertain precisely how long in total Miss Boyce remained underwater some estimates place the duration at around 10 to 20 minutes). When Miss Boyce was eventually freed from the spa, she was placed on the ground adjacent to the spa.

2.9 According to Dr Stellmach, Miss Boyce was "not breathing and had no pulse. She was also quite cyanosed. She appeared to be quite blue. Her pupils were dilated and fixed. Two lifesavers [possibly Scott Metcalfe and Kenneth Moss or Mark Jacobs] who were running a life saving class on the beach came up from the beach to help. They had an Ambu bag and Guedel airway. The lifesavers looked after the airway and the ventilation and Dr Stellmach commenced the external cardiac massage. The young girl vomited soon after CPR was commenced. She was rolled over and her airway was cleared and then CPR recommenced. A short time later, two paramedics arrived and intubated the girl. External cardiac massage continued. Eventually a pulse was retrieved. At no time however did Miss Boyce

show spontaneous respiration and her pupils remained fixed and dilated.

2.10 At approximately 3 p.m. Amanda was airlifted to Nambour Hospital by the Energex Rescue helicopter. Amanda remained in hospital on life support fro a number of days before she was transferred to the Royal Children's Hospital Brisbane.

2.11 At approximately 10 a.m. on Friday 14 December 2002, Miss Boyce's family instructed the hospital to switch off life support. Miss Boyce died shortly thereafter.

EVIDENCE

The Incident

It is clear that the events leading to the death are largely known and uncontroversial. The real issue is to consider ways in which an event of this type can be prevented in the future. I will consider this issue in detail later.

Evidence on day one consisted mostly of persons who were present at the incident. In terms of the events which constitute the incident, the evidence of the witnesses was in accordance with the known facts.

Miss Boyce and her friend entered the Spa and they both placed their heads underwater to wet their hair. Miss Boyce had long hair almost down to her waist. After Miss Boyce was submerged for a time, her friend Miss Reinke thought that something was wrong. She attempted to lift her friend to the surface but was unable to do so. Miss Reinke realising something was wrong screamed for help.

One of the unresolved issues was in respect of how long Miss Boyce was trapped under water. Unfortunately, after the evidence received it is not possible to give an accurate estimate of the time Miss Boyce stayed underwater. Estimates ranged from 5 minutes to 20 minutes. It is simply too

difficult to estimate time. Some persons will think that only a short time has elapsed when others will think it has been an eternity. This is because some people who are completely absorbed by the events will simply not notice time go by. Others who are anxious for an outcome will think that time is dragging on, working against them as it were.

Two things can be said about this. Given that the children were practicing holding their breath in the big pool earlier in the day, it was not surprising that Miss Reinke did not try to see if Miss Boyce was in trouble earlier. She would have thought that Miss Boyce was simply playing on this occasion as well. This would mean that Miss Reinke would not be paying attention to the time, she clearly expected to see her friend surface once she needed to take another breath. There was nothing more or different Miss Reinke could have done to save her friend.

Miss Reinke should be commended for giving evidence in the manner which she did.

Secondly, the evidence of the witnesses, particularly Dr Stellmach was that once the alarm was raised by Miss Reinke, things moved very quickly. Everyone who was involved rendered assistance in a very timely manner. No conclusion can be drawn that more could have been done given the circumstances. All those involved should be commended for rendering assistance in the way that they did. It is not necessary to single out any person but clearly Dr Stellmach's skill and knowledge as a practicing medical practitioner was of great assistance.

The Spa

According to the report of Mr Chandler *The Seahaven Resort was built in 3 stages. Stage 2 (where the incident occurred) was built in 1985. The spa was installed at that time, however it was not completed by the developer (Forester Builders) as the company collapsed…In any event, according to Seahaven management, the installation of the spa was completed by Billabong Pool Service (Billabong Pools). Since 1985, Billabong Pools have performed regular maintenance and repair by Billabong Pools on all spas and pools at Seahaven*

Resort. In July 2001, the pump for no 2 spa (involved in the incident) was replaced.

Mr Mulligan (from Billabong) gave evidence that a pump was supplied for service, but after inspection it became apparent that the pump was uneconomical to repair and it was agreed that a new pump would be fitted. He said, at page 73 of the transcript, *a pump appropriate to the size of the spa would've been selected. I know the pump that was discarded, it was a much bigger pump than the pump we put in.*

One needs to look at the evidence of Mr Herron to put this in context.

Mr Herron says that: *The incident occurred because of a combination of design and operational deficiencies which jointly elevated the risk of hair entrainment within the pump suction piping system. These deficiencies substantially elevated both the risk of hair entrainment and the propensity for hair tangling and knotting after it had been drawn through the suction point covers and into the pump suction piping. The design and operational deficiencies can be summarised as follows:*

- *The suction pipe flow velocities were 35.6% higher than permitted by AS 2610.1.*
- *Excessive suction pipe flow velocity increased the level of turbulence, as measured by the Reynolds number (increased by 29.8%), which compounded the propensity for tangling and knotting within the suction pipe.*
- *Flow velocities passing through the suction point covers were 469% higher than permitted by AS 2610.0.*
- *Excessive velocities passing through the suction point covers increased the Reynolds number by 104% thereby increasing the propensity for tangling and knotting when passing the cover slots.*
- *Excessive velocities passing through the suction point covers also has the effect of increasing the projection of laminae outwards and into the fluid body to assist the migration of foreign bodies into the suction point covers.*

He concluded:

In my opinion the risk of hair entrapment, tangling and knotting within the spa pool pump suction piping system was predictable and could be expected to occur given the high prominence given to this event within the relevant Australian Standard.

If the design risk control measures required by the Standard had been implemented the risk of hair entrapment could have been controlled to an acceptably low level. This low level risk could have been further reduced by implementing additional administrative risk control measures such as the prominent posting of safety notices.

It is my opinion that virtually all the risk control measures required by AS 2610.1 could have been implemented at modest cost. Implementation of these measures would have been sufficient to ensure the safety of spa pool users at the Seahaven Resort.

Mr Herron had undertaken a thorough investigation of this event and had formed very strong views of the preventability of the death in the circumstances of this one. His evidence to the Inquest was clear, concise and most professional. He made it clear that following the Australian standard was essential.

In essence the spa has two outflow outlets in the bottom of the spa. Water is sucked in through these outlets and cleaned and pumped back into the spa under pressure which gives the spa its attraction. Each of the outlets is covered with a plastic cover, a suction point cover. In this case there were three issues which impacted on the velocity of water passing through the outlet pipes or more particularly the right hand outlet pipe. Half of a diving goggle was found in behind the suction point cover. The suction point cover was not in accordance with the standard and it appears that during installation the outlet pipe was crushed thereby reducing its capacity to allow water to flow through at the correct velocity. This becomes very important when regard had to the Reynolds equation.

Mr Herron describes this as follows:

When water is forced to flow through a pipe the resulting flow geometry can range from being very simple to very complex. In general, the various fluid flow regimes can be either laminar, turbulent or in transition between these two discreet forms of fluid flow. To assess the flow geometry an equation referred to as the Reynolds Equation is used to calculate a nondimensional numerical valve which is then used to describe the fluid flow.

In general, a Reynolds number of less than 2000 will indicate that the flow geometry is laminar, and a Reynolds number greater than 2000 will indicate the presence of turbulent flow. For a fixed piping system of uniform internal diameter the flow geometry is principally determined by the fluid velocity. Slow flowing fluids will exhibit laminar flow whilst fast flowing fluids will be turbulent.

When a fluid flow is laminar within a piping system and a foreign body is drawn into the flow, the body will be caused to flow in straight laminae along with the fluid. For a foreign body such as long strands of human hair entrained within a laminar flow, the strands will be caused to lie parallel and tend to avoid becoming tangled with each other.

However, when the fluid flow is highly turbulent long strands of human hair which become entrained within this type of flow regime will be forcibly entwined with a high probability of tangling and knotting. The greater the magnitude of the Reynolds number above 2000 the stronger will be the force producing entwinement, tangling and knotting.

It is important to understand this Reynolds equation because it explains how it was that no one was able to pull Miss Boyce free of the spa. Her hair had become entangled in the turbulence of the water flow. Photos of the suction point cover after the event shows the tangled hair caught in behind the cover. The child could not be removed from the spa until her hair was cut free.

Secondly, it is important to understand the flow issue to determine how in future it may be avoided.

In this case there were a number of issues which needed to be address. Firstly, how did the half goggle get under the suction cover? Secondly, who was responsible for the servicing of the spa and why wasn't the goggle found

and removed from under the suction cover? Thirdly, how was it that the suction cover had come off such that the goggle could get under it? Fourthly, why the suction cover was not in accordance with the standard.

Unfortunately a number of these issues were not satisfactory explained. It is clear from the evidence that Seahaven staff were responsible for cleaning and minor maintenance. Billabong were responsible for the general maintenance and upkeep of the spa. They were responsible for ensuring that the spa was working. Unfortunately, there was no written agreement between these two players. There was no statement of responsibilities. There was nothing that could be pointed to, to show who was responsible for what, how information about the spa was communicated and how repairs and maintenance was authorised and completed.

In this regard it should be noted that Mr Herron noted that Billabong's actions alone did not cause the death. He also noted that Seahaven failed to install an emergency pump stop, alarm and spa pool safety rules significantly contributed to the death but was not the sole cause of the death. The excessive flow rate was a contributing factor.

In this regard it should be noted that Seahaven entered a plea of guilty to a simpliciter breach of section 28(2) of the Workplace Health and Safety Act 1995 and was fined $7,500 and ordered to pay $750.00 professional costs and $2,000.00 investigation costs.

Mr Herron surmised in respect of the goggle, *I believe the screwed thread failed some time ago and Seahaven attempted to overcome this problem by gluing the suction point cover in place to prevent unauthorized removal. It was because of the gluing that a toll was necessary to remove the cover at the time of inspection. However, prior to use of the glue I believe even a child could have easily removed the suction point cover fitted to the blocked branch by hand.*

Generally the spa complied with the standard, AS 2610.1. It had two pump branch connections located at least 500 millimetres apart. This is to ensure that if one gets blocked the full pump flow automatically diverts to the free branch and prevents the generation of high negative pump suction pressures

allowing the obstruction to be easily withdrawn. Unfortunately, on this occasion investigations revealed that the right hand side suction branch was almost completely blocked by half a swimming goggle which was trapped under the protective cover.

It is clear that spa pools can be a danger particularly to children.

Mr Herron was asked a number of questions when giving his evidence about how spa pools could be better designed to substantially reduce the risk of users getting caught under the water. Mr Herron was very strong that design is not the issue. He said that the Australian standard already contains all the requirements to ensure the safe use of spas.

In his report he refers to the standard and in particular clauses 2.8.2 as to alarms and clause 2.19.4 as to signs etc. In particular a cautionary sign should be prominently displayed that:

1. *This spa pool is a heated water environment and if you are concerned that it may adversely affect you it is your responsibility to seek medical advice.*
2. *NEVER PUT HEAD UNDER WATER*
3. *Children must be supervised in the spa pool area.*
4. *Do not use the spa pool area while under the influence of drugs or slcohol (certain medications may produce adverse effects).*
5. *It is safer not to use the spa pool alone.*
6. *It is recommended that you use the spa pool for no longer than 15 minutes at a time.*

NOTES:

1. *Rule 2 should be in red lettering to give it prominence.*

Control Risk control measures recommended were as follows:

The risk of hair entanglement within the pump suction piping system and subsequent drowning within the pool, can be reduced to an acceptable level, if not completely eliminated by implementing four design risk control measures and one administrative risk control measure.

The four proposed design control measures are:

- *Control the suction pipe flow velocity by fitting an orifice plate into the pump discharge pipe. Estimated cost $200.00.*
- *Fit a pressure gauge to the pump suction connection to permit regular testing and verification that both branches of the suction pipe are obstructed. Estimated cost $100.00.*
- *Fit new suction point covers that comply with As 2610.1 to reduce the risk of foreign body entrapment. Estimated cost $100.00.*
- *Fit an emergency spa pool pump stop and associated alarm as required by As 2610.1. Estimated cost $500.00*

The proposed administrative risk control measure is provision of conspicuous signage as required by AS 2610.1 (see Appendix C) Estimated cost $150.00.

The spa pool was later dismantled and rebuilt. The destruction was filmed on a video. I understood the video was to be made available to me but in the end I did not see it. I am satisfied on the evidence of Mr Herron that it was observed during the destruction, that the right outlet pipe was further obstructed by the pipe being partially squashed in, such that water could not flow through it in the correct way, further exacerbating the danger inherent in this spa.

It should be noted that Mr Anderson on behalf of the local council, gave evidence that as manager of building services he conducted an inspection of the spa at the request of Seahaven. The best that can be said about this evidence is that it was some attempt by Seahaven to protect its interests given that Mr Anderson said that he had no great expertise, that the council had no real power over pools and spa's at that time and that he conceded about the report that "they appear to comply but I can't say specifically whether they did or not". It was at best an ill conceived idea by Seahaven.

Findings required by s43(2)

I am required to find, so far as has been proved, who the deceased was and when, where and how she came by her death. As mentioned

earlier, these are not criminal proceedings and I am therefore to apply the civil standard of proof when considering these issues.

Having regard to all of the evidence presented to the inquest I make the following findings:-

Identity of the deceased

The person who died was:- **Amanda Helen Boyce**

Place of death

This person died in the intensive care ward at the Royal Children's Hospital, Brisbane, Queensland

Date of death

This person died on 14 December 2001 at approximately 1000 hrs.

Cause of death

The cause of death was Pneumonia, due to, or as a consequence of, Hypoxic Brain Damage, due to, or as a consequence of, Spa Accident.

Should any person be committed to stand trial?

In addition to the findings concerning the particulars of the death that I have just pronounced, I am also required by s43(2)(b) of the Act to find whether anyone should be charged with murder or manslaughter as a result of the death.

In this case there is no evidence indicating that anyone committed a criminal offence in connection with the death. Therefore, I find that no person should be committed to stand trial on any of the charges listed in s41(1)(a) of the Act.

Riders

Pursuant to s43(5) of the Act I am authorised to make riders or recommendations designed to reduce the occurrence of similar deaths to those investigated by this inquest.

Recommendations

It is clear that spa pools have a propensity to be very dangerous if they do not comply with the requirements of the Australian Standard.

Clearly people with spas at home will have to consider the potential hazards inherent in spa pools and decide if they need to have their spa check for compliance. Clearly any who have children would be well advised to ensure that the following recommendations are complied with.

I make the following recommendations;

1. All public spa pools should comply with the relevant Australian Standard. If they do not then they should be brought into compliance.
2. As a minimum public spa pool owners should:

- Control the suction pipe flow velocity by fitting an orifice plate into the pump discharge pipe.
- Fit a pressure gauge to the pump suction connection to permit regular testing and verification that both branches of the suction pipe are unobstructed.
- Fit new suction point covers that comply with As 2610.1 to reduce the risk of foreign body entrapment.
- Fit an emergency spa pool pump stop and associated alarm as required by As 2610.1.

3. Owners must ensure that all spa pools have a prominent sign which complies with the relevant standard AS 2610.1 clause 2.19.4 and which gives significant prominence to the requirements that CHILDREN BE SUPERVISED IN THE SPA AREA and that USERS NEVER PUT HEAD UNDER WATER.
4. That owners who have service agreements with professional pool cleaners clearly set out in writing the responsibility of each such that each is clearly aware of the obligations that each has to ensure that the spa pool complies with the relevant standards from time to time and most importantly, whose responsibility it is to ensure that the spa is working to an optimum standard to avoid any risk of injury or death to users.

I note that by letter dated 25 February 2004 the Director Legal and Prosecutions Services Workplace Health and Safety Queensland wrote to the deputy State Coroner advising that a draft Health and Safety Alert – Public Spa Pools had been prepared and was in the consultation phase. I am not aware if the alert has been sent. It was comprehensive in its draft form. However, it should now be upgraded where necessary to incorporate these recommendations and published/republished.

Finally I would like to express my condolences to the family of the Deceased, Mr and Mrs Boyce were present during the hearing but had to leave for

overseas where Mr Boyce works soon after. I am sure the hearing was very difficult for them to endure.

I also give my condolences to the Heinke family. When parents take on the responsibility of taking the children of others on holidays, they assume a significant risk. No one expects a tragedy of this magnitude. No doubt the loss of this lovely child will be with them all for ever. It should be noted that there is no suggestion whatsoever that the Heinke family did anything at all to contribute to the death.

I also thank Counsel assisting for his invaluable assistance throughout. I also thank the representatives of the parties for their most helpful contribution.

The Inquest is now closed.

Ray Rinaudo
Acting State Coroner.