CORONERS ACT, 1975 AS AMENDED

SOUTH  *AUSTRALIA*

FINDING OF INQUEST

An Inquest taken on behalf of our Sovereign Lady the Queen at Adelaide in the State of South Australia, on the 13th, 14th, 15th, 16th days of May 2003 and the 25th day of September 2003, before Wayne Cromwell Chivell, a Coroner for the said State, concerning the death of Jessica Anne Gorostiaga.

I, the said Coroner, find that, Jessica Anne Gorostiaga, aged 8 years, late of 51 President Avenue, Andrews Farm, South Australia died at the Women's and Children's Hospital, King William Road, North Adelaide, South Australia on the 12th day of March 2001 as a result of closed head injury.

1. Introduction

1.1. On the afternoon of Sunday 11 March 2001, the Kapunda Harness Racing Club conducted a 'twilight' meeting. The meeting was also a fundraising event for St Columba College at Andrews Farm. The first race was due to commence at 4:32pm.

1.2. The Club had set out to attract families to their functions by offering free entertainment. They contracted with Mr Des Healy of Starlite Amusements to provide entertainment including motorbikes, an animal nursery, pony and camel rides, a face-painter, a hurdy gurdy, and a 'bouncy castle' (see the evidence of Mr Adams, the President of the Club, Exhibit C5a, p1).

1.3. One of those families in attendance was Mr Carlos and Mrs Robin Gorostiaga and their children, Jessica, Raymond, Luke and Paige. Not long after they arrived at the meeting, the children began playing on the 'bouncy castle', a large inflatable structure set up in the car park. In this case, the 'bouncy castle' took the shape of a giraffe, and

was described as the 'Maxi-Giraffe Supa-Bouncer'. I will refer to it as the 'Maxi-Giraffe' in these findings.

1.4. Between 4:00 and 4:15pm, a whirlwind entered the car park and headed straight for the Maxi-Giraffe. It was ripped from its anchors and lifted into the air. Bevan Ladhams, aged 11 years, gave a good description of what happened:

> 'I had lunch with my family after we arrived and then I went over to the rides. I patted the animals and then had one go on the motor bikes, which lasts for 6 minutes. I started to walk back towards to pavilion and then thought to go and have a go on the bouncy castle. I started to walk over towards it, I got in range of about 3 metres and the wind started to blow up even worse. There was dust going everywhere. I got a bit of dust in the corner of my eye, I looked over the carpark which is east and I saw like a mini tornado coming towards the carpark and the bouncy castle. It was coming over the top of the cars, I could see pebbles and bits of rubbish flying around as it passed.
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> I could see about 8-9 kids in the bouncy castle, I kept walking towards it and then all of a sudden the left side of the castle just flew up in the air and then lifted up the right side of it as well. It went up in the air, then tipped upside down and then spun around in circles. I saw some kids falling out of the castle and some others were trying to hang on. I saw a lady try to grab a little girl out of the bouncy castle just before it took off and she was thrown back onto some rocks.
>
> The castle went up about 7 metres, at least as high as a normal light/stobie pole. It would have been in the air for about 20-30 seconds. It seemed like quite a long time that it was in the air but when I think about it properly it is only about 20-30 seconds. When it all happened I just started to run backwards towards the pavilion.
>
> As the castle was flying around it popped a couple of times and was going flat. I could see a girl holding on to the side of the castle, then it hit the ground and she hit the ground as well and she bounced towards the four wheeler motor bikes. She was just lying there unconscious.'
>
> (Exhibit C15a, p1-2)

1.5. The girl described by Bevan Ladhams was Jessica Anne Gorostiaga. Another fifteen people were injured in the incident, several of them seriously.

1.6. The Ambulance Service was called at 4:12pm, and a total of fourteen ambulances and two helicopters attended.

1.7. Dr Robert Lecons, a General Practitioner from Kapunda, attended at 4:31pm and quickly ascertained that Jessica was the most seriously injured. He inserted a Guedell Airway and administered pain relief. Jessica was transferred to an ambulance where she was anaesthetised and intubated. She was transferred to the Kapunda Hospital where she was placed on a ventilator.

1.8. Jessica was retrieved to the Women's and Children's Hospital in Adelaide, arriving at about 7:20pm. Investigations revealed that she had suffered very severe skull fractures with associated brain injuries.

1.9. Tragically, Jessica's condition failed to improve and brain death was eventually diagnosed. Dr Neil Matthews, Head of the Medical Unit, pronounced life extinct at 12:45pm on 12 March 2001 (see Exhibit C2).

2. Cause of death

2.1. A post-mortem examination of the body of the deceased was performed by Dr Lynette Moore, Consultant Histopatholagist on 13 March 2001. Dr Moore's examinations confirmed the presence of skull fractures and underlying brain injuries. Her conclusion was that the cause of Jessica's death was, in very general terms, 'closed head injury' (Exhibit C3a, p1).

2.2. There is no doubt that Jessica sustained these injuries when she hit the ground after the incident described above, and I so find.

3. Weather

3.1. All of the witnesses state that the weather on 11 March 2001 was fine and clear. Senior Constable Paul Kearney from the Kapunda Police Station, who arrived at 4:17pm, described a 'slight breeze from the south west'.

3.2. Mr William Adams, the President of the Club, described it as 'a beautiful day with hardly a breath of wind' (Exhibit C5a, p2).

3.3. Information from the Bureau of Meteorology appended to the Affidavit of Mr Andrew Watson, Regional Director, provides weather information from Nuriootpa (20 kms to the south-east), and Roseworthy (34kms to the south-west of Kapunda). At Nuriootpa, the maximum wind speed recorded was 12 knots (22 km/hr) and at Roseworthy the maximum was 16 knots (30 km/hr). At between 3:30pm and 4:00pm at Nuriootpa, a change in the wind direction from 140° (south-east) to 250° (west-southwest) was noted.

3.4. In a further letter, Mr Watson advised that the main contributing factors to the formation of whirlwinds are:

- 'Heated ground caused by insolation (sunlight on the ground);

- Atmospheric instability in the lowest few hundred metres above the ground;
- Convergence of air near the ground resulting from the interaction of winds from two or more different directions.

A coincidence of the above factors can result in the development of a narrow column of rapidly rising air with rotation, which is the 'whirlwind'.'

(Exhibit C41c, p1)

3.5. Mr Watson stated that there had been 22 events involving whirlwinds in South Australia in the seven years to December 2001, usually involving property damage to roofs and/or vegetation. He stated that based on the magnitude of damage commonly caused by whirlwinds, it is estimated that wind speed within the whirlwind vortex is of the order of 100-120 km/hr (Exhibit C41c, p2).

3.6. Mr Watson stated that there is no evidence that whirlwinds are more common in the Mid North/Kapunda area compared with other areas of the State. Meteorologically, there is no reason why that area is any more conducive to whirlwinds than other areas of similar topographical form or distance from the coast. He said that the car park area at the Kapunda Trotting Complex, being relatively large and open with no large obstructions and little or no vegetation, was 'fairly well suited' to whirlwind development or maintenance (Exhibit C41c, p2).

3.7. Mr Watson indicated that the change in wind direction from south-east to south-west, and the increase in wind speed from 20 to 30 km/hr suggests that there was a sea breeze front originating from Gulf St Vincent passing over the area as it moved inland from the south-west. The passage of the whirlwind from south-west to north-east suggested that it was travelling in a northerly direction along the front as it moved eastward (ibid).

4. Events of 11 March 2001

4.1. The first person to spot the whirlwind on 11 March 2001 appears to have been Mr Stephen A'Court, who was a passenger in a vehicle being driven down the approach road to the Kapunda Trotting Complex. He said:

'At this stage I can remember seeing a large whirly wind coming down the road directly towards us. It was on the opposite side of the road from us and we still had not got to the gate of the complex. I can then recall seeing the whirly wind turn off the road and it went behind a line of large pine trees which I believe are on the border of the Trotting

> Complex property. After that I lost sight of the whirly wind but I can remember it was a large whirly wind and some distance away from us. We then pulled into the second gate of the Trotting Complex and stopped the car to talk to the gate attendant. Some moments later we started to drive off and park the float when I suddenly saw the whirly wind appear on my left hand side coming out of the line of pine trees. We were driving approximately towards a bouncy castle with a giraffe on it and the whirly wind was coming out of the trees at an angle of about 45°. I said to my brother and Jason, I hope the whirly wind doesn't hit the castle or words to that effect, but the wind just hit the castle straight on. It was travelling very quickly and it contained a lot of dust and pine needles and other debris and it seemed to go straight over the top of the castle. At this stage we were about 50 metres from the castle and I saw that the wind was starting to lift the castle. It appeared that the left hand side of the castle lifted first and then the edge closest to us lifted and we could see the underside of the castle. I can't remember seeing any people getting hit by the castle or falling from it, but I saw the whole castle become airborne and it was lifted away from where it was originally positioned and high into the air. I saw it continue to be lifted and at one stage I saw that it was blowing towards the main shed of the complex that houses the betting ring. At that point it was as high as the top of the shed and it was deflating. It started to deflate when it was at about gutter height on the shed. I can clearly remember commenting to my brother and Jason at about this time that I hope there isn't anyone in the castle, or words to that effect. After reaching its highest point it was well deflated and didn't resemble a bouncy castle. It then seemed to get spat out by the whirly wind and it appeared like a big piece of canvas in the air. It seemed to have travelled in a horse shoe or semi circular arc and then it appeared to drop on the ground about in line to where it had started but just to the left of that original position.'
>
> (Exhibit C6a, p1-2)

4.2. Mr Harvey Zbrieski told Senior Constable Kearney that he first saw the 'whirly wind' in the car park. He described how he saw it move behind the main building in the Trotting Complex, and that he saw the head of the 'giraffe' appear twice above the roof line of the main building, and then disappear from view. He went on:

> 'The head had only disappeared momentarily, then I saw the whole castle up in the air. From where I was standing, the whole castle cleared the roofline of the main building. I would estimate that it cleared it by about 3 metres.'
>
> (Exhibit C7a, p3-4)

4.3. Senior Constable Kearney measured the height of the apex of the roof being referred to by Mr Zbrieski, and this was 6.5 metres (Exhibit C38a, p4).

4.4. Several witnesses described a loud 'bang' as the bouncer was being blown around. Ms Jennifer Goldsmith attributed this noise to the detachment of the air compressor hose (Exhibit C10b, p2). The noise might also have been the result of a collision

between the compressor and the door of a truck parked in the area, where damage was observed by Senior Constable Kearney (Exhibit C38a, p2).

4.5. The strength of the whirlwind is illustrated by the statement of Mrs Margaret Potter, Jessica's grandmother. She said:

> 'I heard someone say "Here comes the dust". The three of us turned around to look at the approaching wind and I saw a small swirl of wind approaching from the entrance area of the track car park. This car park entrance was a couple of hundred metres away from us. As we turned back I heard someone say "Close your eyes".
>
> As this was said the wind was all over us, but it was not the wind swirl that I had seen near the entrance as it did not have time to travel that quickly over a long distance. There must have been another one or that smaller one was the fore runner for the bigger one.
>
> The power or force and grit within this swirl was unbreakable and seemed to last forever. I remember fighting against it with every ounce of strength I had to try and keep standing upright.
>
> My skin felt like it was being stripped off me with a piece of sand paper due to the force and grit. I thought I was managing well to stay standing up but then an additional force slammed into me fact first.
>
> At first it felt like I had been slammed into a brick wall and for awhile I thought I had. I now believe, however, that it was the castle which had broken from its moorings and collided with me before slamming (me) into the ground.'
>
> (Exhibit C11a, p3)

4.6. The Maxi-Giraffe was described by Mr Peter Cockerham, the Senior Consultant at Workplace Services Division of the Department of Administrative and Information Services ('Workplace Services'), who was the Principal Investigator of that agency, as follows:

> 'This large amusement structure is approximately 6.9 m X 5.9 m, with a 900 mm bed height, a 1.8 m wall height, and a 10 m overall height. It is manufactured from a strong fabric made up of PVC laminated nylon cloth, and the structure weighs approximately 213 kg, without ancillary equipment and accessories.
>
> The Maxi Giraffe Bouncer consists of 6 anchor points, 1 blow tube, 1 ancillary tube, 2 deflation tubes, and 1 inspection tube. It also has eyelets where an optional sun/rain cover can be attached.
>
> Apart from the electrical blower unit which keeps the structure inflated while it is being operated, the Maxi Giraffe Bouncer has no mechanical parts, and the unrestrained patrons achieve the desired effect by their own self-powered bouncing motion.
>
> When the Maxi Giraffe Bouncer is set up outdoors each of the six anchor points consisting of a black webbing tie and a metal anchor plate, are pegged to the ground with a metal stake or peg.' (Exhibit C57, p2)

5. Erection of Maxi-Giraffe on 11 March 2001

5.1. The equipment was transported to Kapunda by the employees of Starlite Amusements Pty Ltd. They arrived there at about 2:30pm and began setting it up.

5.2. The Maxi-Giraffe was laid out by Walter Barrett and Jason Daly on a groundsheet/tarpaulin to protect it from the surface of the car park. The Maxi-Giraffe was then inflated, and Jason Daly then proceeded to hammer in the stub axles using a sledgehammer. The manner in which the webbing straps were attached to the stub axles in order to anchor the device has been the subject of contradictory evidence from several of the witnesses.

5.3. Mr Daly, in his statement to Inspector Cockerham on 25 May 2001, said:

> 'When I pegged the ride out I put the stub axle through a loop in the black strap. I didn't put the peg through the blue and yellow loop of nylon rope that is tied to the strap. That rope is only used for tying the strap to a solid object or a car if we are erecting the fun bag (bouncer) on a paved area where we can't put in pegs … that is the way I have always done it but I have never attached the blue and yellow rope to the pegs.'
>
> (Exhibit C45a, p3)

5.4. He repeated this assertion in a later statement to Mr Cockerham on 3 August 2001, when, after giving the same explanation, he said:

> 'Others may use the rope to secure the fun bag to the pegs, but I never do. I always use a loop in the black webbing which I then loop over the pegs and that is how I had the fun bag rigged and secured at Kapunda on the day of the accident.'
>
> (Exhibit C45b, p2)

5.5. When he gave oral evidence, Mr Daly contradicted those statements, saying that he sometimes did use the rope to attach the straps to the peg, rather than the webbing. He said that he would do this on occasions, although his evidence about why he would do so was unclear. I found his evidence confusing and contradictory on this issue, and I have little faith in its veracity (T206-208).

5.6. Mr Des Healy, the owner of Starlite Amusements, told me that he had always instructed employees to use the rope tied to the webbing, because an engineer had advised him that the webbing might be abraded if it was allowed to move up and down the peg, and the rope had better wear resistance. He also said that if such abrasion occurred to the rope, it was easier to replace (T85, T92).

5.7. Mr Kym Healy told me that he always used the rope rather than webbing. He said that he had seen Mr Daly attaching the webbing directly to the pins before and had told him to do it with the rope instead, as he thought using the webbing might affect the 'integrity' of the webbing (T38-39).

5.8. Mr Kym Healy said that he checked the anchorage of the Maxi-Giraffe on 11 March 2001 after Mr Daly had finished his work. He said that he noted that there were two instances where Mr Daly had contravened his early instructions, and had tied the webbing directly to the anchor pin rather than using the rope. He said:

> 'I readjusted by taking the peg out of the ground and banging it back in through the rope. I put the peg in a minimum of one foot to a foot and a half. I don't think Jason knew that I shifted them. I didn't adjust the others as they all had the rope through the peg. These pegs were a foot and a foot and a half into the ground.'
>
> (Exhibit C47b, p2)

5.9. Both Mr Desmond Healy and Mr Kym Healy told me that they used stub axles, rather than the anchor pins supplied by Supa-Bounce Pty Ltd, because they regarded them as much stronger, and less likely to bend if being used on hard ground. Mr Desmond Healy says that he told a representative of Supa-Bounce that the pins they supplied were useless, although he was unable to identify whom he told. Mr Burchett had no recollection of ever having heard that information (T118, T131).

5.10. There is no doubt that the method adopted by Mr Healy was not in accordance with the manufacturers specifications. The handbook to which I have already referred, states:

> 'When fully inflated move the bouncer into its desired position, adjust the position of the single stake and drive stakes into all of the other anchor points. The stakes should be driven right down to ground level. They can be removed using a claw hammer or similar. Do not stretch the anchor points tight. Anchor them at their normal extent of travel.'
>
> (Exhibit C58, Appendix A)

5.11. The stakes supplied by Supa-Bounce Pty Ltd were designed to be used in conjunction with the metal anchor plates through which the webbing is threaded. Clearly, the holes in the anchor plates are not big enough to be used in conjunction with the stub axles, which are of a much greater diameter (the supplied pins are 16mm in diameter, whereas the axles range from 25-32mms in diameter).

5.12. Mr Healy told me that the practice of using axle stubs was commonplace in the amusement industry, and that he had been using this method for many years. He pointed out that circuses used them to anchor their tents, and to tether large animals such as elephants (T83).

5.13. Mr Burchett told me that he had never had notice that this method was being used with his equipment, although he was aware that they were used commonly in the amusement industry generally (T118). He said he had manufactured more than 500 bouncers in Australia since he had been operating, and that more than 10,000 bouncers had been manufactured around the world. He said that this was the first time that he had ever been aware of any complaints about the inadequacy of the anchoring system (T131).

5.14. Mr Burchett also argued that using the recommended pins was advantageous because if the pin is driven the whole way into the ground, the anchorage point is at ground level, so that any force exerted on the webbing cannot exert a leverage on the anchor pin. If the webbing is attached to the anchor pin at a higher point than ground level, it will achieve a mechanical advantage and be more likely to pull the peg out of the ground (T135).

5.15. In this case, it is not clear to what extent the axle stubs were driven into the ground by Mr Daly, and by Mr Healy, when he readjusted the pegs later. As I have already said, Mr Healy asserted that he had hammered the peg to a minimum of 1-1.5 feet into the ground (Exhibit C47b, p2).

5.16. Mr Daly told me that he hammered the pegs so that a maximum of one third its length, or about 200mm (8 inches), was protruding from the ground. This is not consistent with the observations of Senior Constable Downey, who found that the pegs that remained in the ground at Kapunda Trotting Complex, were hammered in to a depth of 200, 240 and 280mm respectively (Exhibit C39a, p7). On this evidence, two thirds of the pegs were out of the ground, rather than two thirds in. I have expressed my reservations about Mr Daly's veracity earlier in these findings, so I have considerable doubt about the extent to which the pegs were hammered in.

6. The investigation

6.1. As I have already mentioned, Senior Constable Paul Kearney of the Kapunda Police Station arrived at the scene soon after the incident. When he inspected the scene, he saw a number of stub axles (a motor vehicle component consisting of a shaft 665 to 770 mms long, with a disc-shaped hub at one end). Three of these stub axles were still in an upright position in the ground, another was lying on the ground, and two others were still attached to the Maxi-Giraffe. On the stub axles that were still attached to the Maxi-Giraffe, blue/yellow nylon rope was tied to the axle stubs and to webbing straps which were stitched to the Maxi-Giraffe. On the stub axles that were still in an upright position in the ground, the blue/yellow nylon rope was still attached, but the webbing had parted at a point which corresponded to where the rope was attached to it. On the stub axle that was lying on the ground, there was no rope or webbing attached to it. At the corresponding point on the Maxi-Giraffe, a loop of webbing was still intact, and another loop of blue/yellow nylon rope was still attached to it.

6.2. Senior Constable Nicholas Downey, a crime scene examiner from Elizabeth Police Station, arrived at the scene at about 6:00pm and photographed the area. Photograph 1 of Exhibit C39c shows the three stub axles still in the ground, and a fourth lying on its side some distance away. Senior Constable Downey drew a plan which is Exhibit C39b. He established that the Maxi-Giraffe had six anchor points. He numbered the anchor points from one to six with number one at the front left of the giraffe as one faces it, and proceeding clockwise around the amusement, culminating at the front right of the amusement. He noted that pins numbered one, two and six were still in the ground, number three was lying on the ground, and numbers four and five were still attached to the Maxi-Giraffe.

6.3. Senior Constable Downey also noted the presence of the blower unit (which he referred to as a fan unit) on his plan. The information he received from police officers at the scene was that it was found approximately 2.5 metres north of where the Maxi-Giraffe came to rest. Senior Constable Downey also noted the presence of damage to the driver's door of truck which was parked 16.9 metres north-east of where the Maxi-Giraffe came to rest. Having regard to various witness statements, and the relative positions of equipment after the event, it would seem that the Maxi-Giraffe was driven in a roughly horseshoe shaped path by the whirlwind, initially in a

generally northerly direction, over the mini bike area, over the truck I have just mentioned at which point the blower unit, which was still attached, smashed into the driver's side door, and then in a westerly direction and then curving around to the south where it finished at a point only six metres away from where it started. On a very rough calculation, it would appear to have travelled a total distance of 50 metres or more. Although it can not be stated with any certainty, it would appear that Jessica fell out of the Maxi-Giraffe when it was in the general area of the mini bike track, approximately 12 to 15 metres away from where the Maxi-Giraffe was originally erected.

6.4. Inspectors Richard Szmelter and Richard Ebel from Workplace Services attended the scene that evening and interviewed several of the eyewitnesses. They interviewed Messrs Walter Barrett, Jason Daly and Kym Healy who were employees of Starlite Amusements. Later, in March 2001, the Inspectors took possession of the Maxi-Giraffe, and fixtures and fittings associated therewith, and transported them to a compound at Walkley Heights.

6.5. It was established that the Maxi-Giraffe had been manufactured by Supa-Bounce Pty Ltd, a Victorian company. Further statements were taken from Mr Desmond Healy and Mr Kym Healy, Mr Walter Barrett and Mr Jason Daly and other witnesses.

6.6. Mr Cockerham made the following observations of the anchorage points attached to the Maxi-Giraffe:

> '**Anchorage 1:** Black webbing only left attached to the anchor points. The webbing was torn/broken at approximately the middle of the loop.
>
> **Anchorage 2:** Black webbing only left attached to the anchor points. Very slight stitching stress/damage to the right hand anchor point. The webbing was torn/broken at approximately the middle of the loop, and showed signs of wear.
>
> **Anchorage 3:** Black webbing still intact as a loop. A piece of blue and yellow acrylic rope knotted around the webbing at approximately the middle of the loop. The black webbing showed signs of wear in this area where the knot was tied. The metal anchor plate was attached to the right hand side of the black webbing, but was not attached to the rope.
>
> **Anchorage 4:** Black webbing still intact as a loop. The metal anchor plate was attached to the black webbing and a piece of blue and yellow acrylic rope was looped and secured to the metal anchor plate.
>
> **Anchorage 5:** Black webbing still intact as a loop. A piece of blue and yellow acrylic rope knotted around the webbing at approximately the middle of the loop. The black webbing showed signs of wear in this area where the knot was tied. The metal anchor

plate was attached to the left-hand side of the black webbing, but was not attached to the rope.

Anchorage 6: Black webbing only left attached to the anchor points. The webbing was torn/broken at approximately the middle of the loop.'

(Exhibit C57, p5)

6.7. The corresponding anchorage pins, consisting of stub axles as I have already described, were observed as follows:

'**Pin 1:** 680 mm long, flat end, (no point). A piece of blue and yellow acrylic rope was looped at the top of the peg. The peg had a black texta marking 200mm from the end.

Pin 2: 670 mm long, angle end. A piece of blue and yellow acrylic rope was looped and secured through a hole in the top of the peg. A metal anchor plate was retrieved but was not attached to the peg. The peg had a black texta marking 240mm from the end.

Pin 3: 675 mm long, flat end, no rigging attachments. Remnants of white and orange plastic flagging was attached through a hole in the top of the peg.

Pin 4: 680 mm long, angle end. No rigging attachments.

Pin 5: 765 mm long, flat end. No rigging attachments.

Pin 6: 725 mm long, rounded end. A piece of blue and yellow acrylic rope was looped at the top of the peg, and the top end of the peg still had ancillary fixtures attached. The peg had a black texta marking 280mm from the end.'

(Exhibit C57, p6)

6.8. The Managing Director of Supa-Bounce Pty Ltd, Mr Michael Burchett, was interviewed on 15 June 2001 at his offices in Victoria. Mr Burchett confirmed that the Maxi-Giraffe was fabricated on 11 November 1999, and sold to Mr Desmond Healy on 18 November 1999. He confirmed that an Operators Handbook (Exhibit C53d) was supplied with the equipment, as were a blower unit and anchorage kit. This is confirmed by the invoice, Exhibit C53a.

6.9. On 28 November 2001, Inspector Cockerham and his assistant attended at the Kapunda Trotting Complex with a spare stub axle/anchor pin, and with the 420 mm metal peg supplied with the Maxi Giraffe as part of the 'anchorage kit'. Mr Cockerham reported:

'In the area where the Maxi Giraffe Bouncer had been erected at the time of the accident, Inspector Perry and myself used a 7 pound sledgehammer to hammer the 720 mm spare peg/car axle into the ground. We found the peg could be hammered completely into the hard ground relatively easily. We then hammered the 420 mm metal peg that was supplied with the Maxi Giraffe Bouncer by the manufacturer, and was given to me by Des Healy on the 11th April 2001. We had difficulty hammering this peg through the

hard ground and the peg bent, and in trying to remove the peg from the ground the peg bent further.'

(Exhibit C57, p9)

6.10. Inspector David Kiddie from Workplace Services supervised tests carried out at the facilities of A Noble and Son Ltd at Kilburn, at which the strength of the webbing was tested. Mr Michael Golley, the State Manager of the Company, supervised the testing and recorded the results in Exhibit C56. The testing established:

- A piece of the 50mm webbing, stitched in a loop at each end, had a tensile strength of 26.0 kilo-newtons (kN). This means that when the webbing was stretched by a hydraulic ram, it did not break until a force of 26.0 kN or 2.7 tonnes was applied to it.
- When the webbing was 'choked' at one end, such as would happen if a rope was tied to it, it would withstand a force of only 1.0 tonnes.
- If the webbing was 'slightly worn', it would withstand a force of only 0.9 tonnes.
- When one of the metal anchor plates supplied by Supa-Bounce Pty Ltd was tested, by threading the webbing through the slot in the plate and simply knotting it at one end, the anchorage would withstand a force of only 0.8 tonnes. Significantly, it was the metal fitting which failed, rather than the webbing, in this test. The earlier test demonstrated that when the webbing was knotted, it would withstand 1.4 tonnes, whereas the metal fitting would only stand 0.8 tonnes.

6.11. It is disappointing that a piece of rope of the same blue/yellow type used by Mr Healy, was not attached to the webbing to duplicate the forces which would have been applied to the anchorage system of the Maxi-Giraffe on 11 March 2001. Because the webbing was looped, the tensile strength of a single piece of webbing choked at one end cannot be deduced from the above tests. All that can be inferred is that, by choking it in this manner, the tensile strength of the material is reduced considerably, perhaps by a factor of 50% or more.

6.12. Inspector Mary Aliferis of Workplace Services arranged for the peg and anchor plate supplied by Supa-Bounce Pty Ltd to be examined by a metallurgist at Amdel Ltd, Mr Monty Luke. He told me that both items had been manufactured from ordinary

carbon steel, which could properly be described as ‘mild steel’, which was not a particularly hard steel and nor did it have a particularly high tensile strength (T168).

6.13. This would tend to explain Mr Cockerham’s evidence about the ease with which the peg bent when he was attempting to hammer it into the ground at Kapunda, and the fact that the plate failed at relatively low forces during the testing at A Noble & Son Ltd.

7. The manufacturer’s perspective

7.1. Mr Burchett, the Managing Director of Supa-Bounce Pty Ltd, told me that he had been involved in the manufacture of this type of equipment since 1992. He said he had manufactured 500-600 in that time (T108). He said that the Maxi-Giraffe involved here was supplied in November 1999 (T109). All this equipment is made from materials imported from Supa Bounce Pty Ltd (UK), and built on licence according to their specifications (T112). The six page Handbook (Exhibit C53d) was also written and produced in the UK.

7.2. Mr Burchett said that the webbing attached to the side of the Maxi-Giraffe was designed to be threaded through a slot in a steel anchor plate, which also has a round hole in it. The company also supplied metal pins designed to pass through the anchor plate and driven fully into the ground so that the anchor plate is at ground level (T116).

7.3. Mr Burchett said that he had no knowledge that Mr Healey and his staff were using anything other than the manufacturer-supplied equipment to tether the Maxi-Giraffe, and in particular, that they were using axle half-shafts in lieu of the pins supplied. I must say I found this assertion rather disingenuous, in view of the fact that Mr Burchett professed to be aware that axles were used by ‘showmen’ to tether other equipment (T118).

7.4. Mr Burchett said he was not aware of any suggestion that the pegs he supplied were too soft, or that they bent too easily (T118). He said:

> 'On the contrary, most people praise and like our anchorage system.' (T121)

7.5. Quoting the Handbook (Exhibit C53d), Mr Burchett said that the Maxi-Giraffe was not designed to be used in a wind speed greater than Force 5 on the Beaufort scale, or

about 38.6 km/hr, (T122). He said that this was based upon testing carried out in the UK.

7.6. Mr Burchett said that on 18 April 2001 he conducted his own testing of the anchorage system used in these devices. He said that the pin through the anchor plate was driven into the ground, and webbing was passed through the slot and connected to a chain block. He said that the pin did not commence to move until approximately 500 kilograms force was applied to it (T125). He said that the webbing and the anchor plate showed no sign of damage at that point (T125).

7.7. Mr Burchett rejected any criticism of the anchorage system. He said:

> 'As a group we've made over 10,000 of these inflatables worldwide and they've gone to over 60 countries around the world and we've sold many hundreds of them here and it has not been a problem. We've not had a report of an issue of that kind. I mean, obviously, if the soil is rock hard and you can't get the anchor stake into the ground then you simply don't erect it.' (T131)

7.8. In particular, Mr Burchett deprecated the use of car axles in place of the supplied system. He pointed out that since the axle can not be hammered fully into the ground, and the rope is attached to the top of the axle, there is much greater 'leverage' on the axle tending to pull it out of the ground that would be the case with a pin which is hammered right down to ground level. He also pointed out that the protruding axle is a tripping hazard for children as well (T135).

7.9. As to the design specifications, Mr Burchett said that the company had decided that it was 'safe' to build a Maxi-Giraffe which could withstand a Force 5 (38.5 kilometres per hour) wind, and that it would be 'madness' to expect such a structure to withstand winds of 115 kilometres per hour (T129). I will deal with this issue again when discussing the engineers' reports.

8. The expert evidence

8.1. I heard evidence from two engineers, both very experienced in the area of product design and engineering analysis. I was greatly assisted by their evidence.

8.2. Mr Paul van de Loo was requested by counsel assisting me, Ms Kate Hodder, to assess the design of the Maxi-Giraffe in light of the events of 12 March 2001. Dr Asko Vilenius was requested by the legal representatives of the injured children to undertake the same analysis.

8.3. Attachment mechanisms

Mr van de Loo agreed that the mechanism specified in the Operator Handbook (Exhibit C53d) was inadequate. He agreed that the pins specified would be of little use in wet or sandy soils. For hard ground other mechanisms such as weights, or water bags are suggested, without specifying the weight requirement (Exhibit C58, p4).

8.4. Mr van de Loo said that the operators obviously resorted to use of vehicle axle half-shafts because the pegs supplied were unsuitable for use in hard ground (confirmed by Inspect Cockerham's testing on 28 November 2001, and by Mr Luke's metallurgical testing). It is also noteworthy that Australian Standard 3533.2-1997 suggests the use of axle half-shafts, although that suggestion is only made 'in the absence of (the manufacturer's) instructions (see paragraph 4.7.4). Mr van de Loo also pointed out that the half-shafts are easier to remove from the ground as well (p7).

8.5. The unfortunate outcome of the use of half-shafts in this case, though, is that the operator was forced to find an alternative method of attachment because the shafts were too big to go through the hole in the anchor plates supplied, so they resorted to using rope.

8.6. The use of rope tied to the webbing has substantially reduced the strength of the webbing by 'bunching' it causing uneven distribution of load among the webbing fibres, thereby reducing the breaking strain of the webbing. Those fibres thereby exposed to greater loads fail first, thereby throwing load onto the next fibre, leading to progressive failure (p7).

8.7. Mr van de Loo was unable to comment on the criticism of Mr Burchett, that because the axles were not hammered entirely into the ground, a higher leverage, or turning moment would be exerted on the PEG. He said that detailed wind-loading tests would be required to assess what loads were being placed on the pegs by a given wind force (p8).

8.8. Dr Vilenius agreed with Mr van de Loo's observations. He added:

> 'Given the limited level of information it is still possible to note that had the castle supporting pins been car axles driven fully into the ground, a seat-belt type fitting used on webbings to connect to car axles and the webbing had had a design margin of safety

> of about 6 to 10 (re: AS3533) over the 45 km/hr wind load then it is highly likely that the bouncy castle would have withstood the whirl wind it encountered at Kapunda.
>
> I have performed some calculations myself based upon the information which I have received, and by making some basic and conservative and conservative assumption. From those calculations, it is my opinion that had the Supa Bounce Maxi-Giraffe been erected in accordance with the manufacturer's instructions and suitably improved pins and web plates, with pins inserted correctly in reasonably heavy soil, it could have withstood a single gust of wind force up to 30 metres per second, or approximately 108kph. This is to say that the webbing was suitable, while the web plates and the manufacturer provided pins were not.'
>
> (Exhibit C59, p5)

Dr Vilenius said that using the anchor system in place on 11 March 2001, he thought that the webbing would have failed at a wind speed as low as 40-50 km/hr (p5).

8.9. Mr van de Loo said that he doubted that it would be possible to design a system to withstand a wind force of 108 km/hr (T287).

8.10. Having regard to the evidence of Mrs Potter that she struggled to remain standing upright, Dr Vilenius estimated that the maximum wind speed was likely to have been about 70 km/hr. As I have said, Mr Watson, the meteorologist, said that the wind velocity at the vortex of the whirlwind was likely to have been 100-120 km/hr (Exhibit C41c, p2).

8.11. Conclusions

In summary, then, on the evidence of these highly-qualified engineers, which I accept, I find that the anchorage system specified by Supa Bounce Pty Ltd in its handbook was inadequate. The pins were too soft and liable to bend when being hammered in, and when being removed from hard ground. The anchor plates were also too soft and liable to failure at quite low loads.

8.12. The unsatisfactory design of the anchorage system led Mr Healy to resort to a different system, using car half-shafts and ropes. This was also a flawed system, because although the half-shafts were stronger, they were too big for the anchor plates, necessitating a rope connection between the webbing and the pin. The rope tied to the webbing caused the webbing to fail, thereby leading to the Maxi-Giraffe breaking away from its anchors, and fly through the air causing Jessica Gorostiaga's death.

8.13. It is noteworthy that the pins where the webbing failed, numbers 1, 2 and 6, were on the south-western, or windward side of the structure when it was erected on 11 March 2001. These pins were still in the ground after the incident.

8.14. It follows that these anchorage points were the first to fail, thereby allowing air under the structure, creating the lift described by Dr Vilenius (T303-304). This is also consistent with the eye witness accounts I have already referred to.

8.15. When the structure lifted off the ground, the other three axle stubs were pulled out – number 3 fell away and numbers 4 and 5 remained attached to their ropes.

8.16. From this it can be deduced that it was the failure of the webbing, caused by choking with the rope, rather than the axle stubs lifting out of the ground, which led to this tragedy.

8.17. For those reasons, I disagree with the conclusion of Mr Cockerham, the Workplace Services Inspector:

> 'Despite the fact the inflatable was not rigged, tied down, anchored or pegged in accordance with the recommendation of the manufacturer, it cannot be established that this caused the inflatable's anchor system to fail. In half of the anchorages, the webbing remained intact, but the force was sufficient nevertheless to pull the axles from the ground.'
>
> (Exhibit C57, p15)

8.18. On the contrary, I find that it was the anchorage system adopted by Mr Healy and his staff which caused the failure. As I have said, compliance with the manufacturer's recommendations would not necessarily have avoided the tragedy. The metal anchor plates would have failed at least as soon as the webbing did, or possibly even earlier, on the test results referred to earlier.

8.19. <u>Design issues</u>

Both Mr van de Loo and Dr Vilenius were critical of the lack of appropriate testing of the Maxi-Giraffe before its anchorage system was designed. For example, Dr Vilenius said:

> 'In summary the documented design process and the given calculations are very poor, there is insufficient information given for a structure which is intended to support human beings. In my opinion, the calculations are suspect in quality and do not address sufficient aspects of the design.

For example, the anchorage calculations appear to emphasis the available strength from the pins and then proceed to evaluate the safe wind speed, without providing or using a formal margin of safety.

In my opinion, a more appropriate design would be to first establish the likely conditions which the equipment is to be operated in, ie. maximum average wind speed which should include a maximum short duration gust speed. This should be followed by design of a sufficient mounting/restraining system to carry such loads multiplied with a reasonable margin of safety.

The margin of safety should allow for wear and tear as well as unusually adverse conditions.

If such design could not be arrived at then the behaviour/operation of the structure should be examined and changed so that safe operation (or possible shut down) could be achieved.'

(Exhibit C59, p1-2)

8.20. As to Supa Bounce's assertion that the structure could withstand a wind of Force 5 on the Beaufort Scale, Dr Vilenius said:

'In the manufacturers calculations, no reasonable account of dynamic loading or gust wind loading evaluation has been given. In fact no loading condition evaluation is given, eg. operating region, expected winds, temperature, sun exposure, expected usage, expected over load etc.

In my opinion, a sheet of wind strength scales does not constitute an appropriate evaluation of expected wind conditions for a semi permanent structure. The Supa Bounce Maxi Giraffe was a structure very similar to a tent or a tethered balloon.

Methods to evaluate the probability of wind gusts during use can be found in various design codes (such as AS1170 in civil engineering, FAR Pard 23 and Part 25 and PSD methods in aviation, similarly in marine engineering).
(FAR, Federal Aviation Regulations, USA)
(PSD, Power Spectral Density, statistical method of evaluating the likely frequency and severity of extreme gusts from existing data)

Calculations provided by Supa Bounce do not assume realistic conditions for aerodynamic lift & drag or 'moment' or in fact wind velocity and pressure coefficient.

The pressure coefficient assumed in the calculations is lower than expected for the type of structure (refer AS 1170.2, Hoerner).

Further, no lift coefficient or drag coefficient is used, that is, there is no evaluation of the effect of lift on the structure, and the pressure coefficient used is the horizontal force component only.

The result is that little account of directionality of aerodynamic forces has been taken into account, while too low a value is used for aerodynamic coefficient.

The Maxi Giraffe is an unusually complex shape. It would be easily distorted by wind pressure and is a soft elastic lightweight structure, much like a tethered cold air balloon.

> However, there has been no allowance for aeroelastic behaviour and no evaluation of the effects of bending and distortion.
>
> No factor of safety is shown in the calculations and in my opinion, the results do not leave a sufficient margin for safety.
>
> In my opinion, other components have not been properly evaluated, nor given margins for safety.'
>
> (Exhibit C59, p2-3)

8.21. Mr van de Loo agreed (T281-283).

8.22. The experts are agreed then, that it was inappropriate that the Maxi-Giraffe and its anchorage system involved here were designed first, and the wind strength criteria were established second, and on a very doubtful basis at that. It would have been more appropriate to establish the conditions in which the equipment would be required to operate in first, and then design the equipment to cope with those conditions.

8.23. I have already mentioned that Dr Vilenius thought that a system could be designed to cope with wind gusts of up to 108 km/hr, whereas Mr van de Loo thought otherwise. Dr Vilenius appears to have more extensive qualifications in the particular fields of aeronautical engineering, and he dealt with a number of engineering issues not covered by Mr van de Loo, so I conclude that on the basis of his wider experience, he is more likely to be correct.

8.24. Ultimately, though, it does not matter who is correct on the basis of theory. Both engineers recommend, and I accept, that appropriate wind-velocity testing should establish whether a particular system will cope with the required conditions or not. If it does not, then the system should be redesigned, and if that is not possible, then decisions must be made about whether the equipment should be allowed to be used.

9. Recommendations

9.1. I was told that the new Occupational Health Safety and Welfare Regulations, which came into effect on 1 July 2001 now require the registration of inflatable structures with Workplace Services.

9.2. Unless the design issues raised by the engineers who gave evidence in this matter are addressed, however, there is little that Workplace Services will be able to do to

prevent a recurrence of this event. For example, the evidence in this inquest establishes that had Mr Healy and his staff complied with the manufacturer's instructions as to anchorage of the device it would have been no more, and possibly less safely secured to the ground.

9.3. In my opinion the basic design issues raised in evidence here must be addressed. I recommend that the relevant Australian Standard (AS3533), where it applies to inflatable structures, should be reviewed so that it provides that:

- The expected wind conditions in which such devices are required to operate, including the unexpected sudden changes which sometimes occur (on the basis of the meteorological evidence submitted here), should be established;
- Appropriate anchorage systems, which have been proved to be capable of withstanding such conditions with an appropriate safety margin, can then be specified.

9.4. Once such a Standard is established, Workplace Services should refuse to register any such device, thereby allowing it to be used for profit, unless it complies with that standard.

Key Words: Inflatable Amusement Structures; Australian Standards; Head Injuries

In witness whereof the said Coroner has hereunto set and subscribed his hand and Seal the 25th day of September, 2003.

Coroner