



# OFFICE OF THE STATE CORONER

## FINDINGS OF INQUEST

**CITATION:** Inquest into the death of **Wayne MacDonald**

**TITLE OF COURT:** Coroner's Court

**JURISDICTION:** Mackay

**FILE NO(s):** 2010/4299

**DELIVERED ON:** 9 September 2014

**DELIVERED AT:** Mackay

**HEARING DATE(s):** 23 April 2014 & 21 – 22 May 2014

**FINDINGS OF:** David O'Connell, Central Coroner

**CATCHWORDS:** CORONERS: Inquest – death caused by air blast from burst 22.5 inch truck tyre - "zipper failure" - proximity of truck driver to source of blast - comment upon alternative work procedures - necessity for care in maintaining minimum cold inflation

**REPRESENTATION:**

Counsel Assisting: Mr John Aberdeen  
Spouse: Pam MacDonald  
LCR Mining Group: Ms Elizabeth Wilson QC i/b Herbert Smith Freehills Lawyers  
Anglo Coal (Foxleigh): Mr Peter Roney QC i/b Ashurst Lawyers  
Goodyear: Mr Martin Burns QC i/b Minter Ellison Lawyers

CFMEU: Mr Greg Dalliston

- [1]. Wayne MacDonald was a 53 year old, experienced, truck driver. He worked at a coal mine in the Bowen Basin region of Central Queensland driving heavy trucks which hauled coal. During his work one of the tyres on a trailer failed and was required to be changed. Accordingly he drove his truck to the appropriate facility at the mine site to change the failed tyre.
- [2]. There he used a short handled, manual jack, placed under the appropriate axle of the trailer, to lift the trailer and change the tyre. He had provided to him by a work colleague what was thought to be a suitable replacement tyre from those tyres made available. The tyre that was chosen, from a number that were available, was marked in chalk with the notation "SLOW LEAK/OK".
- [3]. The truck tyre was then inflated to what was considered to be the operational<sup>1</sup> tyre pressure. Mr MacDonald had completed the tyre changing task without incident until he was lowering the trailer to the ground using the jack which required him to place himself between two pairs of wheels on the four axle (double bogie) trailer. As the replacement tyre came into contact with the ground it catastrophically failed, suffering what was later described as a 'zipper failure'. Mr MacDonald, who was then positioned, lying on the ground, between the trailer's tyres, was hit by a percussive shockwave of air causing him fatal injuries. He died at the scene.
- [4]. This inquest will examine the circumstances of Mr MacDonald's death, establish the fundamental cause of the incident, and make recommendations for methods to reduce the risk of catastrophic tyre failure in the mine site environment workplace. It shall also examine what steps should be undertaken before a used tyre is again deemed suitable for service, the appropriate method (or equipment) for the jacking of trailers, and whether an 'Australian Standard'<sup>2</sup> for 24 inch truck tyres should be established.
- [5]. I acknowledge the considered, and very helpful, submissions from Counsel Assisting, Senior Counsel for each of the interested parties, and the representative of the applicable union.

### **Tasks to be performed**

- [6]. As I often state my primary task under the Coroners Act 2003 is to make findings as to who the deceased person is, how, when, where, and what, caused them to die<sup>3</sup>. In Mr MacDonald's case there is no real contest as to who, when, and where he died. The real issues are directed to how and what caused his death from the failure of the tyre.
- [7]. Accordingly the List of Issues for this Inquest are:-

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<sup>1</sup> This is a consideration addressed later in these Findings

<sup>2</sup> Australian Standards are not law, but may become a legislative requirement by the Government passing a law adopting it

<sup>3</sup> Coroners Act 2003 s. 45(2)(a) – (e) inclusive

1. The information required by section 45(2) of the *Coroners Act 2003*, namely: who, how, when, where, and what, caused Mr MacDonald's death,
  2. What caused the failure of the tyre marked "~~SLOW LEAK~~"/"OK" on 18 December 2010?
  3. Can any steps be taken to minimize the risk of tyre burst, through zipper failure, in the mining environment?
  4. Can the practice of changing a tyre be improved, or varied, to reduce the risk of injury or death to persons involved?, and
  5. Whether safety in the mining industry would be enhanced by the adoption of an *Australian Standard* in respect of larger diameter wheels and tyres? (i.e. up to and including 24 inches<sup>4</sup> diameter)
- [8]. The second task in any inquest is for the coroner to make comments on anything connected with the death investigated at an inquest that relate to public health or safety, the administration of justice, or ways to prevent deaths from happening in similar circumstances in the future<sup>5</sup>.
- [9]. The third task is that if I reasonably suspect a person has committed an offence<sup>6</sup>, committed official misconduct<sup>7</sup>, or contravened a person's professional or trade, standard or obligation<sup>8</sup>, then I may refer that information to the appropriate disciplinary body for them to take any action they deem appropriate.
- [10]. In these findings I address these three tasks in their usual order, section 45 Findings, section 46 Coroners Comments, and then section 48 Reporting Offences or Misconduct. I have used headings, for convenience only, for each of these in my findings.

### **Factual background and evidence**

- [11]. The factual background to the matter is not in dispute. After hearing the evidence I received from Counsel Assisting particularly helpful written submissions which set out the factual background. Those matters I adopt, and are helpful to understand the non-contentious matters that led up to the fatal incident.
- [12]. Mr Wayne Robert MacDonald was born on 19th August 1957, and was fatally injured on 18th December 2010, then aged 53 years.

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<sup>4</sup> An intriguing anomaly that a tyre's diameter is measured imperially, yet width is measured metrically, and the profile is expressed as a percentage aspect

<sup>5</sup> *ibid* s.46(1)

<sup>6</sup> *Ibid* s.48(2)

<sup>7</sup> *Ibid* s.48(3)

<sup>8</sup> *Ibid* s.48(4)

- [13]. Mr MacDonald was a married man, who resided with his wife at Hervey Bay. He was employed as a contracted truck driver by LCR Group Pty Ltd, a company based in Brisbane. He was an experienced truck driver.
- [14]. On 17th December 2010, Mr MacDonald was to have worked a 12.5 hour shift (5.45pm -6.15am) at the Foxleigh Mine Site, on Middlemount-Dysart Road, Middlemount, in the Bowen Basin area of Queensland. His duties on this shift were to transport coal using a road train consisting of a Kenworth brand Prime Mover to which was attached a set of three side-tipping coal-carrying trailers (identified at the mine site as Truck 42)<sup>9</sup>.
- [15]. By about 5.15am on the 18th December, Mr MacDonald had completed transporting nine loads of coal, when he called his base and advised that one of his trailers had sustained a flat tyre. His supervisor at LCR, Mr Leigh Wilkie, advised him to drive to a location called "The Mailbox", where the tyre could be changed. This was appropriate.
- [16]. "The Mailbox" is a type of small depot where, among other activities, flat tyres on transport units can be changed under cover, and on a flat and relatively-clean, level, concrete surface.
- [17]. Mr MacDonald drove Truck 42 to The Mailbox, and brought it to rest with the relevant part of the complete rig under cover and upon the concrete pad<sup>10</sup>. He was initially assisted with changing the tyre by the supervisor Mr Wilkie, until another LCR truck driver, Mr Alex Hutchinson, took over from Mr Wilkie. It was generally accepted within LCR that the task of changing a tyre on one of these road-trains was a "two-person" task.
- [18]. At this point it is useful to describe the salient features of the tyre changing process Mr MacDonald used.
- [19]. The flat tyre was the outside tyre of a dual configuration. The tyre-changing process commenced with Mr MacDonald crawling through the space between the two middle axles (of four axles at that location on the trailer) entering between the tyres for the purpose of placing a bottle jack under a lifting point on the trailer<sup>11</sup>. Using a short jack handle, he then raised the vehicle, and the flat tyre, with the bottle jack. The available space between the flat tyre, and its rearward neighbour, is critical to a consideration of what happened to Mr MacDonald<sup>12</sup>.

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<sup>9</sup> This is a "C-Triple" configuration.

<sup>10</sup> Exhibit E1 and E2 contain a number of photos taken of truck 42 in situ at The Mailbox where it remained throughout this incident.

<sup>11</sup> The precise jacking point used by Mr MacDonald is not completely clear. The tyre-blast pushed the bottle jack across the ground, from the passenger's side of the trailer, where it had been raised, to the driver's side: exhibit E1 (photograph Image 34) showing the point behind a wheel on the driver's side where the jack came to rest. There is no suggestion at all that the point of jacking chosen by Mr MacDonald to jack up the vehicle was in any way relevant to what transpired, rather where he was required to place himself is relevant.

<sup>12</sup> The space is clearly shown in exhibit E1(photograph Image 40).

- [20]. Mr Wilkie chose a replacement tyre from among a number of tyres stored, and made available for use, at The Mailbox. He chose a tyre with similar wear and apparent condition to the other tyres on truck 42<sup>13</sup>. This tyre, at some previous time, had the words "Slow Leak" marked on the sidewall. These words had been crossed out (or ruled through), and the letters "OK" marked in white on the outer sidewall<sup>14</sup>. Mr Wilkie then inflated the tyre, using the protective cage to hold the tyre during inflation, from 30 p.s.i. (storage pressure) to 110 p.s.i.<sup>15</sup>, which was believed to be the appropriate operating pressure. By way of illustration of the high pressure in an inflated truck tyre one must realise that, from general knowledge, a standard passenger car has a tyre pressure of around 34 p.s.i. A truck tyre also holds a significantly greater volume of air due to its 24 inch diameter size. I will comment on the potential energy of such stored air pressure in a truck tyre below.
- [21]. At about this time, Mr Hutchinson arrived and took over providing assistance to Mr MacDonald, while Mr Wilkie went to continue with his supervision duties. Mr Hutchinson collected the necessary tools to change the tyre, and removed the now-inflated tyre from the cage in which Mr Wilkie had inflated it<sup>16</sup>.
- [22]. Mr MacDonald and Mr Hutchinson together then removed the nuts holding the flat tyre with the "rattle-gun", removed the flat tyre, and replaced it with the tyre which had been selected and inflated by Mr Wilkie. The wheel nuts were secured, again with the rattle-gun. This was all routine procedure and occurred without incident.
- [23]. Once the replacement wheel had been fixed in place, the tools were put away, and all that remained to be done was to lower the vehicle back onto all wheels by letting-down the bottle jack. Mr MacDonald, who was standing in the vicinity of the changed wheel, suggested to Mr Hutchinson that Mr Hutchinson go and remove his "lock" from the vehicle. Mr Hutchinson then walked away to remove his lock<sup>17</sup>.
- [24]. Mr MacDonald then crawled, on the ground, beneath the trailer through the small gap between the two tyres. He released the jack, and the trailer then began to settle down onto all wheels. At this time Mr Hutchinson had just removed his wheel lock, when he heard what he described as an "explosion"<sup>18</sup>.

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<sup>13</sup> It does not appear that tread depth was measured; but rather assessed by eye only. Clearly there would have to be a close approximation of tread on the replacement tyre, with the tread on the remaining inside-mounted tyre, to facilitate equal load bearing on both tyres.

<sup>14</sup> The logical conclusion to be drawn from these markings is that the tyre, at some time past, had been found to be deflating slowly; this has led to its removal and to the marking of the tyre with the words "slow leak"; it has then been repaired, and when that has been done, the words "slow leak" have been lined through, and the letters "OK" painted on the sidewall.

<sup>15</sup> Exhibit C2 Interview Transcript Leigh WILKIE of 21/01/11, Answer 140.

<sup>16</sup> Exhibit C2 Interview Transcript Alex HUTCHINSON of 07/06/11, Answer 41.

<sup>17</sup> Summarised from Exhibit C2 Interview Transcript Alex HUTCHINSON 07/06/11, pp 5 to 8.

<sup>18</sup> Exhibit C2 Transcript HUTCHINSON (referred to above in 16) Answer 162.

- [25]. Mr Hutchinson is certain that the trailer was back on its wheels when he removed his lock<sup>19</sup>.
- [26]. As no-one was present and observing Mr MacDonald at this time, it is only possible to draw an inference as to what occurred next. The logical inference that I draw is that the trailer settled back on its wheels, and the subject tyre then failed as it came under pressure due to its contact with the ground under the unladen weight of the trailer. When it failed it released a powerful air-blast. This may have occurred as soon as the weight of the trailer came to bear upon the wheel in question<sup>20</sup>; but it cannot be completely discounted that a couple of seconds elapsed between weight-bearing and rupture.
- [27]. At the time of the air-blast, Mr MacDonald may have been lying on his right side, or perhaps partly on his side and partly on his back<sup>21</sup>, between the two wheels, with a portion of his upper body not readily visible to a person standing beside the trailer. Whether he was on his back or partly his side is of no great consequence.
- [28]. Upon hearing the explosion, Mr Hutchinson returned immediately to where he had left Mr MacDonald. He saw that Mr MacDonald was lying on his side, and was not moving. He called Mr MacDonald's name, and shook him, but there was no response. He then called for assistance, and he was joined by Mr Wilkie and another worker, Mr Michael Clements. Each of these three men tried unsuccessfully to rouse Mr MacDonald. They then dragged him out from between the wheels.
- [29]. Once Mr MacDonald had been brought out from under the truck, it became apparent that he had been seriously injured. The employees of LCR who were present requested immediate assistance, and other personnel from the mine's Emergency Response Team (ERT) subsequently arrived, later to be joined by QAS officers. Mr MacDonald remained unconscious, was unable to be revived, and passed away at the scene.

**Results of Autopsy:**

- [30]. Life was certified to be extinct at the scene of the incident by QAS officer Bryan Keith, at 6.35am on 18th December 2010.
- [31]. An autopsy was conducted by a forensic pathologist, Dr Nigel Buxton, at Rockhampton at 8.30am on the 19th December 2010. Out of respect

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<sup>19</sup> Exhibit C2 where in his interview he observed at Answer 133: "...no locks come off until you know its all down on the ground".

<sup>20</sup> The air-blast propelled the bottle-jack across the ground under the trailer, to the position where it stopped, and was later photographed, against the inside of the driver's-side wheel. This lateral movement would appear to point almost incontestably to the inference that the jack, at the time of the air-blast, was *not* bearing the load of the raised trailer, the explosion could thus have occurred at any point (within a timeframe of a few seconds) after the release of the load from the jack.

<sup>21</sup> Exhibit C2 Transcript HUTCHINSON (referred to above at 16) Answer 166.

to Mr MacDonald and his family I do not restate the detail of Dr Buxton's catastrophic injury observations in my Coronial Findings. The autopsy report is exhibit A4 should the specific details of the injuries be relevant for any later purpose. The summary of the forensic pathologists findings are all that is necessary for the purposes of this inquest.

[32] Relevantly Dr Buxton's summary and interpretation stated:

*"Death in this patient is due to multiple injuries (cerebral contusions, pulmonary collapse, pulmonary laceration and fractured ribs) as a result of a blast injury affecting the chest and to a lesser extent the head. There is no evidence that a physical object actually hit the gentleman. The injuries are more in keeping with high pressure compressed air. There is no evidence of significant pre-existing natural illness."*

[33] The more serious injuries were to Mr MacDonald's right chest and side, with substantial but lesser injury to his head. External observation did not signal the extent of internal injury. Based on these pathological findings it is reasonable for me to infer that Mr MacDonald was not struck by any object or debris, and that he was very close to the source of the blast. His position on the ground, and near the tyre that failed, would have resulted in the full force of the blast being absorbed by his body which, due to his position on the ground and being between tyres in a small space, meant that his body was unable to move in reaction to the blast.

***The nature of tyre-blast injury:***

[34] There is some use, by way of background information, in providing a simple overview of the types of forces involved in these incidents. These tyre-blasts produce very significant energy. To place this into perspective for the ordinary person one interested party to this inquest produced a document<sup>22</sup> from the tyre manufacturer which relevantly states that the force of a burst tyre has enough energy to lift a small car, a 'Mazda 3' model motor vehicle, eight metres into the air. I feel this adequately conveys to the layman the extent of the forces at work in a truck tyre blast.

[35] Of significance to the circumstances of this incident I note that on 21 March 2007, Coroner Hennessey concluded an inquest<sup>23</sup> in Rockhampton involving the death of Mr S W Davis, also as a result of a tyre blast. I note that this also occurred at Foxleigh Mine, the same mine as Mr MacDonald's death, although the haulage contractor at that time was not LCR Mining Group. In the course of that inquest, her Honour referred to a further matter of Mr Peter Marshall, an inquest<sup>24</sup> concluded on 19 May 2006, in respect of a death at the Century Zinc

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<sup>22</sup> Exhibit D4, appendix PK-9, slide 37

<sup>23</sup> Exhibit G2

<sup>24</sup> Exhibit G1

Mine. Clearly tyre blast, in whatever circumstances, in the mining industry is not entirely unheard of, and should not be considered as a 'one in a billion event', as described by one person<sup>25</sup> who gave evidence. Certain industry practices to minimise the risks associated with tyre blast need to change.

[36] At the inquest a great deal of information was provided by investigators<sup>26</sup>, the owners of the mine<sup>27</sup>, the tyre suppliers<sup>28</sup>, the contractor trucking company<sup>29</sup>, and the union representing the coal industry employees<sup>30</sup>. This broad cross-section of interests in the coal mining industry provided a significant opportunity for the interests of all parties to be put forward.

[37] It is easiest, and most relevant, to address the evidence presented at the inquest, as it relates to each distinct issue, under section 45, section 46, and then section 48.

### ***Coroners Act s. 45: 'Coroner's Findings'***

[38] As I stated in paragraph [6] above, there is no contest over who, when, and where Mr McDonald died. The real issue is how and what caused Mr MacDonald to die.

[39] Ultimately, after hearing the evidence, it was clear that how Mr MacDonald died was due to a tyre failure, known as a zipper failure, which failure caused a catastrophic percussive shockwave of air to strike him, whilst he lay in the confined space between two sets of wheels on the trailer as he undertook the task of replacing a damaged tyre.

[40] Similarly, the evidence provided at the inquest was clear, and there was no contest or dispute, that what caused Mr MacDonald to die were multiple injuries, due to, or as a consequence of, tyre explosion as described by the forensic pathologist.

### **Issue 1**

[41] Accordingly Issue 1 on the List of Issues for Inquest is that required by section 45 (2) of the Coroners Act 2003, and accordingly I find the following:

- a. Who the deceased person is – Wayne Robert McDonald;
- b. How the person died – Mr MacDonald death was due to a tyre failure, known as a zipper failure, which caused a

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<sup>25</sup> T1 – 36 [10] Mr John Sleight, Mines Inspectorate, and note two prior inquests involving mine site tyre blast deaths held in 2006 and 2007, being exhibits G1 and G2

<sup>26</sup> Mines Inspectorate

<sup>27</sup> Anglo Coal (Foxleigh Management) Pty Ltd

<sup>28</sup> Goodyear & Dunlop Tyres (Australia) Pty Ltd, formerly South Pacific Tyres which group incorporates the familiar trade name Beaurepaires Tyres

<sup>29</sup> LCR Group Pty Ltd, which includes LCR Mining Group

<sup>30</sup> Construction Forestry Mining and Energy Union (CFMEU)



catastrophic percussive shockwave of air to strike him, whilst he lay in the confined space between two sets of wheels of a trailer as he undertook the task of replacing a damaged tyre;

- c. When the person died – 18 December, 2010;
- d. Where the person died – ‘Foxleigh’ Mine Site, on Middlemount-Dysart Road, Middlemount, Queensland;
- e. What caused that person to die – multiple injuries, due to, or as a consequence of, tyre explosion.

## **Issue 2**

- [42] The second issue, Issue 2 was “What caused the failure of the tyre marked “~~SLOW LEAK~~/OK” on the 18th December 2010”.
- [43] There was a great deal of focus at the inquest on what precisely could be established of the events that led up to the failure of the tyre.
- [44] It was accepted by all parties that the ‘failure’ of the tyre was a zipper failure, which is said to occur as a result of ply cord failure in the steel radial chords, or plies, in the tyre wall. Mr Southwell, the independent tyre expert who actually examined the particular tyre, found that this was the reason that the tyre failed on 18 December 2010.
- [45] What preceding events led to the tyre failing in this way was far more contentious between the parties, and this occupied a significant amount of exploration at the inquest, and in submissions.
- [46] Put very broadly zipper failure, on the evidence of the experts, can occur through two main events. Firstly, from the operation of the tyre well outside its design load/speed/inflation pressure limits, leading to a weakening in the steel cords of the tyre’s plies, or, secondly, through any accidental sidewall damage which has weakened the steel cords of the tyre. An example of this was damage to a tyre in its handling, prior to any use, through being impacted by forklift tines, causing sidewall damage, for example a cut.
- [47] Mr Southwell who conducted a thorough physical examination of the tyre found there was no evidence that the sidewall had been damaged through accidental damage, such as its handling prior to use. The experts all agreed that the likely reason for the zipper failure which occurred in Mr MacDonald’s case was due to the tyre being operated for a period of time outside its design parameters.
- [48] Counsel for LCR very strongly suggested that there was insufficient evidence to conclude what caused the failure of the tyre except to concede that it was a zipper failure. It was strongly suggested to me that there was no evidence as to the actual history of this particular tyre, nor any evidence that it was operated in an underinflated state, such that it would be susceptible to excessive flexing of the steel cords of the tyre.

- [49] There was no evidence of the particular serviceable history of this tyre except that it was known that the tyre was not brand-new, and that it had been in service previously. It is reasonable to draw the inference, which I do, that the particular tyre that failed had previously suffered a puncture because there was a repaired puncture in the tyre's tread. Naturally a puncture would, when it occurred, lead to a lessening of pressure in the tyre, which is likely why the tyre was actually marked "slow leak". If the tyre had a slow leak then, it is logical and reasonable to conclude that at some stage the particular tyre had been operated in an underinflated state. What is important in this matter is that I do not have sufficient evidence of whether this tyre, in an underinflated state, was used for 100 metres or 100 km or even never used in that state at all. There is simply no service records of this tyre, which is not at all unusual.
- [50] In saying that what I do appreciate is that the expert evidence established that the particular tyre in question was found to be in a relatively good condition and showing no obvious signs of being operated in an overdeflected state, when examined by Mr Southwell<sup>31</sup>.
- [51] Ultimately, in view of the evidence presented, I am unable to precisely determine the service history, or usage, of this particular tyre, but I am able to determine that the tyre failed due to a zipper failure, which evidence all of the parties accepted was correct.
- [52] Most importantly, in this coronial jurisdiction, I need to look at what steps should now be taken to minimise the future risk of injury caused by such failures.

### **Issue 3**

- [53] Can any steps be taken to minimise the risk of tyre burst, through zipper failure, in the mining environment?
- [54] When considering the matter one must always be aware of the practical realities that exist in the mining environment. The mining environment is not pristine, or 'laboratory like', in the conditions that exist and under which workers and machinery operate. The evidence that I accept was that the mining environment of Foxleigh mine, which in my experience is very common throughout Bowen basin mine sites, is that road surfaces can be very harsh on equipment, particularly tyres. The evidence given at this inquest was that the road surface conditions could change daily, even though a regime of road maintenance was undertaken. I do recognise the harshness of the environment, particularly for tyres, which does influence me when considering appropriate, and practical, recommendations, particularly when the experts agree that tyre zipper failure can occur without any external evidence, or warning, of the tyre's impending failure.

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<sup>31</sup> T2 – 61 & 62

- [55] The evidence presented showed that zipper failure can occur without any noticeable warning signs, and the only possible sign of an impending zipper failure may be a slight metallic pinging sound as steel cords break as the tyre is being inflated. It was noted that at the mine site, which I understood was industry practise, that tyres were inflated in an appropriate steel cage so that if zipper failure occurred during inflation potential injury to persons was minimised.
- [56] The zipper failure in Mr MacDonald case occurred after the tyre had been successfully inflated to what was believed to be the operating pressure. The tyre was then safely handled as it was changed. The evidence suggested that as the tyre came under load, at the time it came into contact with the ground, it then catastrophically failed. Put at its simplest, Mr McDonald was injured because of the position he was then in, close to the zipper failure, and in an enclosed space.
- [57] Can any steps be taken to minimise this risk from tyre burst? Certainly there can be steps taken. Leaving aside the issue of an Australian Standard in respect of these larger diameter wheels and tyres (dealt with in Issue 5), the minimisation of risk can occur through the tyre initially being pressured tested, for a short period of time above their correct operating pressure by being overinflated by approximately 20% whilst in the steel tyre inflation cage.
- [58] Evidence was given at the inquest of the practice adopted where tyres were tested by inflating them to approximately 20% above their operating pressure, and leaving the tyre inflated for approximately 20 minutes, before deflating them to their operational pressure and then putting the tyre into service. It was considered that this simple step lessened the risk of tyre failure because the tyre had already demonstrated, in the controlled environment of the steel inflation cage, that it could satisfactorily accept a higher pressure, even if that high pressure had only occurred in a static environment, rather than in a dynamic environment of its actual use.
- [59] The process of changing a tyre does not place any dynamic stress on the tyre, until the tyre comes into contact with the ground under the load of the trailer, whether laden or unladen. Whilst no evidence was given to me as to the likely dynamic forces on the tyre when the tyre comes under into contact with the ground, it is certainly reasonable that first testing the tyre with a higher inflation pressure (of 120% of its operational pressure) should lessen the risk of subsequent failure in the circumstances Mr MacDonald faced. No doubt when the tyre is operating in the work environment it will be subjected to greater dynamic pressures, but at this time the operator will be located in the cabin of the vehicle, well away from any field of impact from an exploding tyre.

- [60] It was evident that the practice at the mine site, indeed safe practice adopted everywhere with these types of tyres, was that they are inflated in a steel cage. Clearly the process of inflating them to 120% of their operational pressure, and their remaining in this overinflated state for 20 minutes, should not unnecessarily interfere with good work practices, and certainly should not incur any significant extra cost, particularly as the operator can be busied in other required work for that short period of time.
- [61] Accordingly it is appropriate that a recommendation along these lines be made.

#### **Issue 4**

- [62] Can the practice of changing a tyre be improved or varied to reduce the risk of injury or death to persons involved?
- [63] It is clear that the unprotected human body is highly-vulnerable to serious tyre-blast injury. The seriousness of injury depends largely upon the proximity of the victim to the source of the blast, and the essential features (e.g. power and direction) of the blast. The risk of injury of course increases as the time spent by the person within the blast zone increases. In this respect, it would follow that any preventative recommendation should be based upon the dual aims of *increasing* the distance between the subject and the blast source, and *decreasing* the time necessarily spent by the subject within the blast zone.
- [64] There are compelling reasons why the system of work adopted by Mr MacDonald, of crawling between the two sets of dual wheels, should be condemned. Firstly, it placed him much too close to the tyres as a potential source of danger, and secondly, his position meant that in the event of a tyre blast, his body would be unable to 'compensate' for any application of force through bodily movement, instead he would necessarily have to absorb the full force of the blast<sup>32</sup>. Thirdly, he would have been in this position of danger for far too long - when placing the jack, when raising the trailer with the jack, and then when lowering and removing the jack.
- [65] Options worthy of consideration in this respect may include the use of remote operation jacks<sup>33</sup> or quite simple 'long handled' jacks where the operator never enters the restricted space. Evidence presented at the inquest was that long handled trolley jacks could readily be made and

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<sup>32</sup> The specifics of this incident highlight the particular tragedy presented here. Of the sixty-two (62) potential sources of tyre-blast on Truck 42, it was a tyre directly next to Mr MacDonald which happened to explode; and the site of the zipper fracture on the inside of the failed tyre had the effect that virtually the full force of the blast was channelled towards Mr MacDonald.

<sup>33</sup> This remote positioning of personnel was mentioned in Anglo-American's FLASH ALERT of 18/12/10, but no suggestions were included as to how this was to be achieved: see Appendix 4.3a to Final Report to Chief Inspector of Coal Mines, 17/10/11.

utilised. Indeed it was a simple process to engineer an extendable arm on the existing trolley jack to move the operator further away from the point of jacking. Importantly it meant the operator was away from the restricted, or confined, space between tyres.

- [66] The cost of modifying the existing jacks was said to be minimal<sup>34</sup>, and had already been implemented at the mine site<sup>35</sup>. Clearly a recommendation along these lines should be made. Anecdotally I also mention that the minesite owner temporarily banned the use of bottle jacks as they require the operator to reach in to place them at the jacking point under the axle, whereas trolley jacks may be steered into position by the jacking arm which can now extend some metres in length.

## Issue 5

- [67] Whether safety in the mining industry would be enhanced by the adoption of an *Australian Standard* in respect of larger diameter wheels and tyres? (i.e. up to and including 24 inches diameter).
- [68] At present there is no Australian Standard applicable to large diameter wheels and tyres, up to 24 inches, which were being used at the mine site when Mr MacDonald died. In this respect I am not being critical of the mine owners, the truck operators engaged there, or the tyre suppliers, rather there is simply a total absence of an Australian Standard for the sized tyres.
- [69] What is disappointing is that prior inquests<sup>36</sup> in Queensland have made recommendations for an Australian Standard to be revised (in the Inquest of Marshall) or alternatively reviewed or created (in the Inquest of Davis), but so far it appears to have simply fallen upon deaf ears. That does not mean that a recommendation for an Australian Standard should not be pursued, rather the call simply needs to be made louder.
- [70] Overall the parties before me could all see a benefit in a standard being devised, and that view was for an Australian Standard, or the adoption of a Recognised Standard under the Coal Mining Safety and Health Act 1999. It is clear that there are benefits in a standard being introduced for these types of tyres. If it is implemented as a Recognised Standard under the industry specific coal mining safety legislation then it will be limited in its applicability to only that industry, and workplace, in Queensland. The better view is that an Australian Standard be adopted so that if that standard is adopted into law by regulation it applies, industry-wide, across Australia.

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<sup>34</sup> A 'few hundred dollars' and a metal handle constructed as an extendable sleeve of the existing arm were said in evidence to be readily manufactured to suit.

<sup>35</sup> An example is shown in a series of colour photographs in exhibit D2 at page 10

<sup>36</sup> Exhibit G1, Inquest of Peter Whitoria Marshall (19 May 2006), exhibit G2, Inquest of Shane William Davis (21 March 2007)

[71] What is involved in creating or devising the applicable Australian Standard, or who should be a member of the committee to investigate that standard, are not matters I can properly comment on, but an inquest certainly can make a recommendation that a standard, along the lines of an Australian Standard, be pursued. This measure will take a period of time.

### **Additional Issues**

#### *The practise of 'tyre tapping'*

[72] As the inquest progressed certain industry practises were canvassed and it is appropriate that I provide my observations on these practises. Each of the practises directly relate to safety.

[73] Firstly evidence was given that experienced truck drivers test tyre pressures by process called 'tyre tapping'. This involves the use of hitting the side of an inflated tyre with a metal bar to listen for an appropriate sound which indicates whether the tyre is at the appropriate pressure. It was said that an experienced operator can readily use this method to determine if his tyre pressures are correct. No evidence was given as to precisely how this method can determine between correct inflation, and slightly less than correct inflation, but evidence was given from tyre experts that under inflation may be a percentage of just 4%. It is very difficult to accept that even an experienced truck driver would be able through tyre tapping to discern the difference in pressure of just 5%, which percentage would mean the tyre require further inflation as they are then outside the 4% margin, or range, of appropriate pressure.

[74] I am also conscious of the fact that a tyre audit, under the direction of the Mines Inspectorate, was conducted in January 2011. Of the 248 tyres inspected on four truck and trailer configurations (consisting of 62 tyres each), only 172 were able to be tested. Most of the inside-mounted tyres could not be accessed for testing, which is a fair indication that they would rarely have been checked in daily use, nor maintained at the recommended inflation pressure. The tested pressures found at this audit ranged from 70 p.s.i. to 130 p.s.i.<sup>37</sup>. Clearly all inside tyres need valve extenders to ensure they may be checked from the outside alignment of the truck or trailers.

[75] I fully accept that this audit occurred after the particular trucks would have been sitting idle for a period of time due to wet weather, and so

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<sup>37</sup> A graphical representation is contained in Mr Southwell's report (cited above) at p 10. Both Mr Scott Storey (Interview Transcript 07/06/11, p 15) and Mr Heath Secker (Interview Transcript, 07/06/11, Answer: 403 *et seq*) referred to inquiries being undertaken by LCR as to the availability of suitable remote monitoring systems for tyre pressure. At that time, they were unaware of a suitable unit for possible application to coal-carrying road trains although in evidence (see T2-108 – 111) from a LCR representative at the inquest it was confirmed that these were now being trialled at the mine site.

interpretation of the data collected must be done cautiously, but what the audit was useful for is demonstrating:-

- a. the significant range of pressures between the tyres that were able to be tested,
- b. that only 172 of the 248 tyres (a little less than 70%) were actually able to be tested, and
- c. just how time consuming the task of individual testing the tyre pressures was on this 62 tyre combination.

[76] Responsibly, and as a credit to them, LCR Group has been exploring options for improved safety in this regard. I was impressed by the positive steps taken by their management to investigate the monitoring of tyre pressures through the use of tyre pressure sensors. As soon as you realise that the C- triple truck and trailer configuration has sixty-two tyres, and many of which could not be reached by an operator standing beside the truck and trailers, it is entirely appropriate that tyre pressure monitoring systems be further explored. This view is enhanced when the evidence from an inspector, who attempted<sup>38</sup> an inspection of the tyres to obtain their pressure, took nearly 2.5 hours.

[77] I am very conscious that any recommendation needs to be practical for the environment in which the recommendation shall 'operate', and must not be cost prohibitive, even though there will be cost. In addition any preventive strategies should be directed to the goal of maintaining correct fleet tyre pressures by reference to the prevailing conditions.

[78] The rough guide given in evidence<sup>39</sup> at the inquest was that the cost of wireless tyre pressure monitoring systems was approximately \$11,000 for a truck and its three trailers plus \$3,000 to fit them. No doubt through time, and volume, those costs will reduce<sup>40</sup>. Whilst initially this might be considered a significant expense one must remember there are sixty-two tyres involved and a significant cost due to the length of the C-triple configuration which provides certain operational difficulties for wireless technology. What was clear is that technology currently exists, and could be implemented in the mine environment with all the harshness that it gives to equipment. Whilst the cost may seem significant, it is not a great financial impost when the cost of the entire configuration of truck and trailer is considered. The evidence<sup>41</sup> was that a single tyre is worth some \$600, and if correct operational pressure is kept of a tyre its' service life will be longer and the \$11,000 initial cost quickly recouped in achieving optimal tyre service life. This is without

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<sup>38</sup> The person tried but could not take the pressure of every tyre, rather could only read just less than 70% of the tyres

<sup>39</sup> T2-110 [40]

<sup>40</sup> Once motor vehicle tyre monitoring systems were only available on upmarket vehicles, they are now available on Australian built cars as this Coroner has observed

<sup>41</sup> T2-110[30]

even factoring in the time-saving of the operator not having to check the tyres manually<sup>42</sup>, but rather by reading a gauge in the cabin. Most significantly this practise will keep the operator well clear of potential tyre burst because the operator need not leave the cabin of the truck to check their tyre pressures.

[79] The industry needs to move toward remote tyre pressure monitoring and this should be implemented within a timeframe. One of the considerable benefits of Queensland's regional coroner model is that the coroner, and the registry staff, work and reside in the community in which their cases arise. This allows them to be familiar with issues, trends, and circumstances occurring within their region. I am very aware of the significant challenges faced by the coalmining industry at the present time. Accordingly whilst I would usually seek a shorter timeframe for the implementation of a safety measure I feel there needs to be a small period of additional time for the investigation and implementation of a workable remote tyre monitoring system. I consider that in the current environment this can be permitted, as a recommendation will be made to discontinue the practice of tyre tapping, as the implementation of the checking of tyre pressure by accurate, calibrated, gauges should be commenced immediately. Therefore I consider that two years is more than adequate for remote tyre pressure monitoring systems to be implemented.

### ***Appropriate tyre pressures***

[80] The truck tyres used on Mr MacDonald's truck had embossed on the sidewall a maximum inflation pressure of 125 psi. As the Mines Inspectorate conducted their investigations they interviewed a number of truck drivers at the mine site which revealed substantial differences in their knowledge as to the "correct" tyre pressure. Estimates of correct type pressure understanding included estimates of 100 p.s.i., 110 p.s.i., 120 p.s.i. and 125 p.s.i. by "hands on" personnel<sup>43</sup>.

[81] In addition, specifically for Mr MacDonald, a competency assessment<sup>44</sup> undertaken on 1 August 2007 recorded an answer for correct tyre inflation pressures of 120 psi, which his employer marked as correct. At the inquest evidence was given that this was wrong and actually provided an underinflation situation. Underinflation exposes the tyre to potential sidewall failure, which can lead to zipper failure.

[82] In very short compass the appropriate operational pressure was said to be approximately 140 psi, experts differing slightly.

[83] At its briefest the tyres used at Foxleigh mine site were standard 22.5 inch diameter truck tyres which are ordinarily limited to a maximum tyre pressure of 125 psi as the run at highway speeds of 100 or 110 km/h.

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<sup>42</sup> Which I was told occurs a number of times each shift

<sup>43</sup> these were given by Mr Wilkie, Mr Thorpe, Mr Clements, and Mr Secker, respectively and are contained in exhibit C2

<sup>44</sup> exhibit C2, appendix 8.3



For the particular application on the C-triple configuration hauling coal, being an off-road situation, a special allowance, or 'dispensation' as it was termed, was given by the tyre supplier Goodyear, to LCR Group to use these tyres for hauling the heavy coal loads provided that the tyre pressures were increased above the maximum recommended 125 psi, and that the vehicle did not exceed 40 kph<sup>45</sup>.

[84] Essentially this dispensation was notified to LCR Group by Goodyear by way of a *PowerPoint*® presentation. The particular slide<sup>46</sup> was No. 9, which slide provided:-

**315/80 22.5 Load Concession**

South Pacific Tyres has given dispensation to carry

**4500 kg/Tyre .... Dual**

**Provided the following criteria are met:**

- 1) inflation pressure is a minimum of 130 psi (910 kpa) .. **cold**
- 2) Average loaded speed over the haul averages 40 – 50 km/h

[85] To me that is an extraordinarily lax method for conveying essential information to a customer, especially when one considers the circumstances in which the information was conveyed, at a special meeting convened to consider operational issues, including these tyres. The appropriate method would be for formal written communication, by letter, where the parameters of the vehicle's operating at the mine site were recorded, particularly the configurations of the trailers, loads, road conditions, and speed, were all set out, and then it would state or specify the particular tyres, with its 'special dispensation' as to operational maximum speed, maximum load, and minimum tyre pressure. A prudent supplier would also ensure that the customer acknowledged receipt of the dispensation terms, and had understood the parameters of that dispensation.

[86] The confusion in relation to the minimum tyre pressure being provided by *PowerPoint*® presentation is highlighted by the fact that a member of the mine site managements forwarded minutes of the meeting involving the *PowerPoint* presentation to others, which included the Goodyear representative. Those minutes incorrectly stated a lower minimum inflation pressure. That misunderstanding was never corrected by Goodyear.

[87] In addition the same representative of Goodyear (who gave the dispensation by *PowerPoint*® slide) later noticed a sign on the mine site which indicated an inflation pressure of only 125 psi, which was less than the Goodyear recommended 130 psi. This placard was on the wall in the tyre servicing area at the mine site but again the Goodyear representative seemingly did nothing about this.

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<sup>45</sup> this may well be another anomaly in the appropriate use of the tyres as information was that the trucks did exceed 40 km/h in their approximately 55 km haulage loop.

<sup>46</sup> Exhibit D4, appendix PK-9, at slide 9

- [88] All this leads to the result that there was clearly a great deal of confusion within LCR Group employees, both in management<sup>47</sup> and the operational workforce, as to what the appropriate pressure of the tyres was meant to be. Indeed a great deal of evidence, and submissions, were devoted to 'who, said what, to whom' about the appropriate tyre pressures. It is not necessary for me in this Coronial jurisdiction to resolve that issue specifically but what is clear, and the conclusion that I do draw, is that the end-user, the truck driver, merely thought they had to inflate the tyres to a maximum 125 psi, because that was what was marked on the sidewall of the tyre. On the advice of the tyre experts<sup>48</sup>, this is an underinflation situation, even when I adopt the highest pressure of 125 psi. from the range<sup>49</sup> given by the truck drivers.
- [89] This confusion could well have led to tyres at the mine site, leaving aside the particular tyre that failed in this instance, being operated outside the recommended parameters for speed, road conditions and inflation pressures for the load they are designed to carry. It is clear to me that a recommendation needs to be made that mines review their tyre management practices to ensure that tyres are being operated within their appropriate parameters. It is also appropriate that an annual review occur to ensure compliance takes place. These are relatively simple measures to put in place and do not involve great cost. There will be a benefit in truck drivers having to spend less time changing damaged tyres, and contractors and mine site operators will benefit through longer service life from each tyre.
- [90] From the evidence it is very clear to me that whatever dispensation was granted, or advice given, by Goodyear to LCR, that this information did not filter through to the actual truck drivers. Clearly this situation needs to be addressed. The best way to ensure that the end user of the tyre knows what is the appropriate pressure can be achieved by simply reading the sidewall of the tyre, especially so where it has been provided for this industry specific purpose under a dispensation. In this instance Goodyear manufactured the tyre, then provided the tyre. Indeed they provided a great deal of the maintenance at the mine site. In this situation the best way to communicate to the truck driver what the appropriate pressure should be is to have this embossed on the sidewall.
- [91] I am aware that these particular tyres were manufactured in Turkey, and the mould in which they were created will have marked the usual sealed highway maximum speed, and maximum inflation pressure, into

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<sup>47</sup> for instance Mr Quirk, the most senior LCR Group employee on site, thought the appropriate tyre pressure was 125 psi

<sup>48</sup> the expert opinion given ranged from 140psi by Dr Grigg, to 144 psi by Mr Southwell, leaving aside any question as to the appropriate maximum speed. Goodyear stated 130 psi but they are an interested party.

<sup>49</sup> See paragraph [77] above

the sidewall, but when the tyre is supplied with a site specific, and use specific, dispensation then surely it is not a difficult task to have this embossed onto the sidewall of the tyre i.e. 'maximum speed 45km/h, minimum cold pressure 140 psi' at the time it is supplied to the mine site. Any original embossed markings should be crossed through to show that they no longer apply.

[92] This will ensure that the dispensation terms are conveyed to the actual end user, the truck driver, who in fact is the person 'at the coalface'<sup>50</sup> as it is termed. This can be implemented at very little cost immediately. Accordingly a recommendation along these lines is appropriate.

***Coroners Act s. 46: 'Coroners Comments'  
(Recommendations)***

[93] This incident does provide the opportunity to recommend important improvements aimed at reducing the risk to workers in similar operations.

[94] Whilst I suggested to the interested parties that they confer and provide to the court a list of suggested recommendations agreed by them I observe that this has not occurred for whatever reason. It would have been beneficial to have agreement across the spectrum of interested parties in this matter, particularly as the interested parties include a mine owner, equipment supplier, mine site contractor, union representative, and the next of kin. If agreed recommendations from the parties had been suggested to me then there is a greater likelihood that those recommendations, which likely would have been adopted, being implemented. I did receive from the interested parties, individually, suggested recommendations.

[95] In accordance with my obligation under the *Coroners Act 2003* I now make recommendations that I consider should be implemented.

[96] Any recommendation needs to consider certain important aspects, namely that they be sufficiently practical, they be, within reason, cost-effective, and can be achieved utilising, or readily created using, existing technology. If these fundamental aspects can be met there is a greater likelihood that the particular recommendation will be implemented.

[97] In consideration of the evidence of this case, and for the reasons I have set out above, I recommend the following:-

- 1) That management of mine sites, and their engaged contractors, review all tyre management practices to ensure that tyres on their mine sites are being operated within their specific design parameters applicable for their

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<sup>50</sup> I do not intend this remark to be humorous, nor a pun. I realise the actual workplace is a coal mine, it is merely a readily understood phrase.

use. This review needs to occur within three months, and then annually the mine site needs to ensure that compliance is being maintained.

- 2) That any jack used by an operator has a handle of sufficient length to allow the operator to safely use the jack without the operator being in, or under, the truck or trailer, or within close proximity of the vehicle's tyres whilst jacking occurs.
- 3) That the industry investigate, and implement within two years, remote, or wireless, tyre pressure sensing equipment to allow operators to monitor tyre pressures from within the cabin of the truck;
- 4) That until remote or wireless tyre pressure sensing equipment is introduced for these mine site tyres that the practice of tyre tapping should not be continued, and that accurate, calibrated, pressure gauge should be used to check correct tyre inflation whenever operational requirements dictate that pressures are to be checked;
- 5) That an Australian Standard for up to 24 inch diameter truck tyres be investigated, created, and, if considered appropriate, implemented into law by regulation within a period of two years, and if no Australian Standard is created within two years then a Recognised Standard under Part 5 of the Coal Mining Safety and Health Act 1999 be implemented within one year;
- 6) That whenever a tyre supplier grants a dispensation from the designed operating parameters of a tyre, that the tyre supplier provide, and receive written acknowledgement of from the customer, an appropriate and formal information package which clearly specifies the approved conditions of operation of that dispensation;
- 7) That whenever a tyre supplier grants a dispensation which a mine site operator uses, that the equipments owners and operators incorporate into their written training and operating procedures the specific details of those dispensations;
- 8) That whenever a tyre manufacturer grants a dispensation from the designed operating parameters of a tyre, that the variations be permanently embossed (alternatively termed 'tyre stamping') on the sidewall of the tyre, and that the embossing be completed in a method which is not readily removable, and remains legible, throughout the tyre's serviceable life;

- 9) That every tyre, whether new or repaired, undergo integrity testing by its inflation in a suitable tyre inflation cage, to a pressure of 120% of the tyre's recommended minimum cold operational inflation pressure, and then left for 20 minutes to test its integrity, before its pressure is then reduced to its recommended minimum operating pressure before the tyre is then fitted for use.

**Coroners Act s. 48: 'Reporting Offences or Misconduct'**

[98] The Coroners Act section 48 imposes an obligation to report offences or misconduct.

[99] Expert evidence at the inquest on the condition of the tyre, and most importantly the cause of its failure, included that given by the independent tyre expert, Mr Southwell. As stated earlier he was engaged by the Mines Inspectorate. I was very impressed by his evidence.

[100] Mr Southwell had the opportunity, shortly after the incident occurred in 2010, to inspect the actual tyre which failed, whereas experts such as Dr Grigg<sup>51</sup> did not. I also preferred Mr Southwell's evidence over the evidence called by an interested party, Goodyear, which person was employed by, and gave evidence on behalf of, that interested party to assist the inquest.

[101] Mr Southwell conducted a thorough examination of the subject tyre. His evidence, essentially, was that the tyre was in good condition and that an examination prior to its' failure would not have shown the defect which led to the zipper failure<sup>52</sup>. As relevantly highlighted by Senior Counsel for LCR Group Pty Ltd, Mr Southwell examined a number of elements of the tyre and found:

- a. The depth of the tread remaining on the tyre indicates that the tyre had completed a relatively short portion of its available service life<sup>53</sup>;
- b. the inner liner was found to be in as new condition with the exception of the aforementioned repair patch, and the major sidewall injury described below. The patch was found to be in the correct orientation<sup>54</sup>;
- c. The liner was located and was found to be entirely intact<sup>55</sup>;
- d. The inner liner provides no clue as to the cause of the failure<sup>56</sup>;

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<sup>51</sup> Who incidentally confirmed that he had never examined a tyre zipper failure, T2-78 [15-30]

<sup>52</sup> Exhibit C2, appendix 4.5

<sup>53</sup> Exhibit C2 appendix 4.5 page 5 section 4a

<sup>54</sup> Exhibit C2 appendix 4.5 page 5 section 4b

<sup>55</sup> Exhibit C2 appendix 4.5 page 5 section 4b

- e. There is no evidence of discolouration in this case; that said, the tyre has completed only a relatively small portion of its total available service life, and I would therefore not expect to observe any line of discolouration<sup>57</sup>;
- f. the beads exhibited no evidence of the tyre having been operated in grossly overloaded or underinflated conditions for any significant distance<sup>58</sup>;
- g. no abnormalities were found other than the area in which the tyre had clearly failed on the serial no. side<sup>59</sup>;
- h. other than the actual area of the failure, the condition of the side walls provides no indicators as to the cause of the tyre failure<sup>60</sup>;
- i. it appears that the repair was in fact recently made, and that the tyre had not been used since the repair was installed<sup>61</sup>;
- j. there is no evidence of the tyre having been significantly structurally compromised by the original injury, or by the repair process<sup>62</sup>; and
- k. .... there is no significant evidence on the tyre to suggest extended periods of operation in a grossly underinflated state and accordingly there is no evidence to support a 'leaking valve hypothesis'<sup>63</sup>.

[102] These are all very relevant observations by the independent tyre expert regarding the particular tyre of what could be macroscopically observed, and then determined, as to its usage and history based on the examination. Put in its most simple terms, the wear pattern of the critical tyre did not show continual under inflation<sup>64</sup>, and there was no particular visual evidence of impending zipper failure.

[103] All the factors identified by Mr Southwell are persuasive to me as to whether any possible 'offence' or 'misconduct' may have occurred in relation to the use, or handling, of this particular failed tyre. It was not suggested, nor recommended, to me by any party at the inquest that any person or entity should be referred for investigation of an indictable or other offence. Ultimately any such referral for investigation is a decision for me.

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<sup>56</sup> Exhibit C2 appendix 4.5 page 7 section 5b

<sup>57</sup> Exhibit C2 appendix 4.5 page 7 section 5b

<sup>58</sup> Exhibit C2 appendix 4.5 page 5 section 4c

<sup>59</sup> Exhibit C2 appendix 4.5 page 5 section 4d

<sup>60</sup> Exhibit C2 appendix 4.5 page 8 section 5d

<sup>61</sup> Exhibit C2 appendix 4.5 page 8 section 5e

<sup>62</sup> Exhibit C2 appendix 4.5 page 8 section 5e

<sup>63</sup> Exhibit C2 appendix 4.5 page 8 section 5f

<sup>64</sup> Also commonly termed 'being operated in an over-deflected state', see T2-61 [5]

[104] In the particular circumstances, and on the evidence available in this inquest, I make no such referrals under section 48.

**Magistrate O'Connell**  
Central Coroner  
Mackay  
8 September 2014