GRANTHAM FLOODS COMMISSION OF INQUIRY

SUBMISSIONS OF QUEENSLAND RAIL

Introduction

1. The Grantham Floods Commission of Inquiry (the Commission) was established to inquire into events surrounding the flooding of the Lockyer Creek between Helidon and Grantham on 10 January 2011. On 17 August 2015 Queensland Rail (QR) was granted leave to appear in relation to item 3(a) of the Terms of Reference, namely:

> *"(a) the flooding of the Lockyer Creek between Helidon and Grantham on 10 January 2011, with specific reference to any natural or man-made features of the landscape which could have altered or contributed to the flooding."*

2. The railway line and its embankment ("the railway line") is a man-made feature. The railway line forms part of QR's operating railway network between Brisbane and Toowoomba.

3. The 10 January 2011 flood event that occurred in Grantham was a catastrophic natural event resulting from a unique weather system. While the railway line had an influence during the flooding event that occurred on 10 January 2011, it is clear from the evidence that the railway line was not the cause of the losses suffered in Grantham.

Grantham railway line

4. The railway line has been a feature of the landscape in the Grantham area for well over 100 years (built pre 1893 flood)[1], and potentially up to 145 years (if built as early as 1865)[2]. It was recognised by the previous Queensland Floods Commission of Inquiry that QR seeks to make its infrastructure 'flood free' where possible, eg by building it above the 1 in 100 flood level[3].

[1] Kathleen Mahon - Ex 31(b) at [8]; Ex 31(a) at [3]
[2] Stephen Jones Mayor Lockyer Valley Regional Council - Ex 96 at [11]; T p. 965 l. 36
[3] Queensland Floods Commission of Inquiry – Final Report page 255

5. In the past, the higher ground of the railway line had been recognised and utilised by the local people of Grantham as a safe haven for themselves and their cars in anticipation of floodwaters inundating property[4] and as an evacuation route during times of flooding.

6. For example, Mrs Mahon's father (Wendell Charles), always told her that if she saw water breaking from the western side of the farm house to head to the railway line, as it was the highest point around[5].

7. Martin Warburton gave evidence that his planned escape route was towards the railway line[6]. He explained this plan to a swift water rescue team who checked on his welfare on the evening of 9 January 2011, and it was Mr Warburton's impression that they were satisfied with this plan[7].

8. It was on 10 January 2011 that this historical knowledge proved invaluable. There were numerous examples of the railway line being utilised by people to escape to safer ground as the quickly changing situation unfolded[8]. This is particularly well illustrated by the evidence of Robert Wilkin[9], James Wilkin[10], Lisa Spierling and Natasha Long as well as the photographs forming exhibit 13.

9. When Lisa Spierling's neighbour Rob Wilkin[11] alerted her that Grantham would be flooded and the situation was rapidly changing, they fled with their children from their homes up the embankment to the top of the railway line and then ran across the bridge to reach the higher school grounds[12].

10. Similarly, Natasha Long and her family sought the safety of the railway line when they realised that floodwater was coming[13]. They made it as far as the railway fence, where Natasha Long's mother, Michelle Keep and her brother, Brendan Keep, were rescued by a boat that took them to the railway line[14]. Mrs Long and her husband were carried by

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[4] For example, Michael Darlington – Ex 191(a) at [11]; Allan Patrick Marshall – Ex 30(b) at [11]; Lisa Spierling – Ex 20(a) at [31]; Martin Craig Warburton – Ex 38 (c) at [12]; Moira June Richardson – Ex 238 at [13]
[5] Kathleen Mahon – Ex 31(b) at [8]
[6] Martin Craig Warburton - Ex 38(c) at [35]; T p. 372 l. 16-22
[7] Martin Craig Warburton – Ex 38(c) at [18]; T p. 372 l. 16-22
[8] Geoffrey Purton – Ex 237 at [23]-[24]; James Wilkin – Ex 266 at [18],[23],[32], [34] and [43]; Robert Wilkin - Ex 268 at [26], [30] and [41]
[9] Robert Wilkin - Ex 268 at [28], [30] and [41]
[10] James Wilkin – Ex 266 at [18],[23],[32] and [34]
[11] Robert Wilkin - Ex 268 at [26], [30] and [41]
[12] Lisa Spierling – Ex 20(a) at [35] to [46]
[13] Statement of Natasha Long to the Queensland Police Service dated 9 February 2011 at [27] and [28]
[14] Statement of Natasha Long to the Queensland Police Service dated 9 February 2011 at [33]

the current of the floodwaters to the railway bridge[15]. When they reached the railway bridge, they were pulled out of the water, and they ran along the railway line until they reached the high ground of the school[16].

11. In the photographs[17] it is clearly evident that during the flood event a number of people were standing on the railway line out of the floodwaters.

12. It is also noted that Wendy Gorman used the railway line to evacuate her residence on Gatton-Helidon Road at approximately 1:00 am on 10 January 2011[18].

The rainfall event on 10 January 2011

13. The town of Grantham is an isolated community, located on a floodplain within a high flood hazard zone[19]. It is susceptible to flooding (eg affected by a 1:50 AEP flood)[20]. Depth velocity products (flow intensity) of greater that $1m^2/s$ also affects the area which SKM notes results *"in an unacceptable level of flood hazard"*[21].

14. Despite that susceptibility, Dr Macintosh stated that a flood of this nature had never before been experienced in the Lockyer Valley's recorded history, and particularly in the area of Grantham[22]. It was a flash flood in the Lockyer Valley, driven by an extreme rainfall event and was only rarely expected to occur[23]. The magnitude and rapid rise of the flood produced inundation characteristics never before experienced or imagined by the residents of Grantham.[24]

15. Mr Newton (WRM) expresses it differently in his report but to the same effect. He states that due to the extreme magnitude and rate of rise of the 10 January 2011 event, it is inappropriate to infer how this flood should have behaved by reference to previous historical floods[25]. This flood in the Lockyer Creek was much larger and rose much faster than any living person had experienced[26].

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[15] Statement of Natasha Long to the Queensland Police Service dated 9 February 2011 at [32]
[16] Statement of Natasha Long to the Queensland Police Service dated 9 February 2011 at [36] – [37]
[17] Ex 13
[18] Statement of Wendy Lorraine Gorman dated 28 February 2011 at [8]-[9]; statement of Fiona Wendy Gorman dated at 14 February 2011 at [10]-[14]; Robert Wilkin – Ex 268 at [11]
[19] Ex 3 SKM Report, para 11.8.2 page 107
[20] Et 3 SKM Report, para 9.3.4 (3) and (4), page 75
[21] Ex 3 SKM Report , para 9.3.4(4) page 75
[22] Ex 144, para 9 pages 20-21, Report of Dr Macintosh dated 11 August 2015
[23] Ex 144, para 9 pages 20-21, Report of Dr Macintosh dated 11 August 2015
[24] Ex 144, para 10 page 21, Report of Dr Macintosh dated 11 August 2015
[25] Ex 166, para 76 page 43, WRM Supplementary Report 17 August 2015
[26] Ex 166, para 76 page 43, WRM Supplementary Report 17 August 2015

16. The statements of Dr Macintosh and Mr Newton accord with the accounts of the local residents.

17. The Lockyer Creek is a large catchment of 350 km^2[27]. Sandy Creek is a smaller catchment of 61 km^2[28]. The flooding resulted from an intense two-hour storm burst[29]. BOM investigations revealed that the shape of the weather system uniquely matched the ‘bowl’ shape at the top of the Lockyer catchment[30]. This resulted in high intensity rainfall falling wholly within the upper catchment, with significantly lower amounts in the lower catchment areas (including Grantham)[31]. The Helidon gauging station data shows that the flood flow commenced at Helidon at just after 2.00 pm, and peaked at a flow depth of 8.3 m in just one hour (3.10 pm)[32]. Dr Macintosh considers this to be very rapid[33]. Through the survey of peak water levels ,DNRM determined that the water ultimately peaked at 13.88 m at the Helidon gauge[34].

18. Prior to 10 January 2011:[35]

    a. all catchments of the Lockyer Valley and headwaters were effectively saturated on account of preceding rainfalls over December 2010 and early January 2011 (before the 10th); and

    b. the Helidon Post Office (Station Number 040096) had recorded daily rainfall totals of 123 mm over the 7 days prior to 10 January 2011, and 503 mm over the 31 days prior (6th December to 9th January).

19. As a consequence, runoff from the 10 January 2011 storm was maximised, as little rainfall was lost to soil moisture stores[36].

20. Mr Newton (WRM) notes that the peak flood level at Helidon was about 5 m higher than any other historical floods since 1974, and the rate of rise was at least 4 times faster[37]. Mr Szylkarski (DHI) described the rising water as a very fast rate of rise[38]. Dr

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[27] T p. 1291 l. 30-34
[28] T p. 1291 1. 30-34
[29] Ex 144 page 49 para 134
[30] Ex 144 page 50 para 139
[31] Ex 144 page 50 para 139
[32] Ex 144 page 50 para 144
[33] Ex 144 page 50 para 144
[34] T p. 1121 l. 3-18
[35] Ex 144 page 49 para136
[36] Ex 144, page 49 para 136
[37] Ex 19, page 32 para 55, page 33 figure 4.1 and para 106
[38] T p. 1360 1. 30

Macintosh comments in his report[39] that the highest flow rate measured to date at the Helidon Station is 108 m^3/sec recorded in 1988 (3.4 m GL). Dr McIntosh calculated the peak discharge at the Helidon gauging station at over 4500 m^3/sec, being about 900 m^3/sec more than DNRM[40]. At the peak of the flood, by the time the water gets to the quarry it is about 3800 m^3/sec[41].

21. The effect of extreme flow velocities and the rate of rise in Lockyer Creek at Helidon meant the flood had dramatic effects on the hydraulic characteristics of the channel, which was almost stripped of vegetation during the flood[42]. This change in channel roughness would have had a very large effect on the flow carrying capacity of the channel[43]. Stefan Szylkarski expresses the opinion that the behaviour of the flooding was due to the unique and natural configuration of the floodplain[44].

22. The AEP figures provide a useful context. The 2014 flood study provided to Lockyer Valley Regional Council by SKM estimated the probability of the flood at the Helidon Gauge on the Lockyer Creek as being around 1: 400 AEP[45]. Dr Macintosh placed the flood in the order of magnitude of a 1:300 or 1: 400 AEP event[46]. In that same SKM report it is also stated that in the upper parts of Lockyer Creek (which fed into the Grantham flooding) the event resulted in flood levels higher than an estimated 1:2000 AEP.[47]

23. Dr Macintosh's evidence that the flooding was an enormous flood by historical proportions[48] is entirely consistent with the probability figures. It was an extremely rare flood, and by the frequency analysis you would not expect to see it again in your lifetime[49]. Mr Newton states that the magnitude of the flood event of 10 January 2011 was so great that its impacts on Grantham were inevitable[50].

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[39] Ex 144 page 44 para 109
[40] T p. 1126 l. 15-23
[41] T p. 1233 1. 45- p. 1234 1.1
[42] Dr Macintosh calculated a revised flow hydrograph at the Helidon Station as having a peak rate of 4,600m3 /s, approximately 25% greater than that from the original DNRM estimate. Ex 144, page 63, para 192
[43] Ex 19, page 54, para 108
[44] Ex 163, page 1 para 6
[45] Ex 144, pages 20-21, para 9 (At page 24, SKM's report suggests Grantham was approximately 6.5km downstream from Helidon. At page 9 the report suggests a distance of approximately 10km)
[46] T p. 1239 1. 19-20
[47] Ex 3, page 8, bullet point 3
[48] T p. 1239 1. 9-10
[49] T p. 1239 1. 14-15
[50] Ex 166, page 39, para 69, WRM Supplementary Report 17 August 2015

24. The State Coroner noted that the mathematical probabilities of the type of meteorological event occurring, which caused the Grantham Flood, were 'most unusual'[51].

25. The flooding was the devastating consequence of an extreme natural event[52]. The flooding was an unprecedented, exceptionally large, rapidly developing, fast rising and extremely hazardous natural event[53].

Hazardous nature of the 10 January 2011 event

26. Mr Smith (UNSW), a water safety expert, gave evidence in relation to floodwaters and the associated dangers of those waters to humans and infrastructure.

27. In its simplest terms, the damage and danger that floodwaters might cause can be related to the force of the flood flows (depth and speed) as they travel down a floodplain[54]. Deeper, faster flows can impart more force and cause more damage than in slow shallow flows[55]. Dr Macintosh stated that he specifically chose intensity (depth x flow) rather than depth for the simulations because in this instance it is the intensity, which is more meaningful for interpretation when it comes to hazard and danger[56].

28. The Flood Hazard Vulnerability Curve presented in figure 3 of exhibit 142[57] is extracted from the Best Practice Floodplain Manual prepared by the Australian Emergency Management Institute[58]. The Flood Hazard Vulnerability Curves are classified from H1 through to H6. At H3 the event is unsafe for children and the elderly. Once an event falls within the H5 curve it is classified as unsafe for people and vehicles and buildings require special engineering design and construction.

29. Water with a flow intensity of $2m^2$/sec or greater falls within H5. At $4m^2$/sec or greater the hazard moves to H6.

30. Mr Smith expressed the following opinions in relation to flood water hazards:

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[51] Ex 110, Inquest into the deaths caused by the south-east Queensland Floods of January 2011, page 7
[52] Ex 19, page 3, para 5, (see also para 61 page 34); Ex 144, page 50, para 145 and Ex 3 page 26
[53] Ex 163, page 2, para 7(a); Ex 19, page 88, para 172
[54] Ex 142 pg 2
[55] Ex 142 pg 2
[56] T p. 1146 l. 4-12
[57] Ex 142 p. 6
[58] T p. 1082 l 7-11

a. fit adults walking through floodwaters can become unstable when flow depths exceed 1.2 m. Primary school age children and the elderly members of the community may become vulnerable to toppling over in flood waters deeper than 0.5 m[59];

b. residential buildings are at risk of failure once flood flows are greater than 1.0 m deep in combination with flow speeds greater than 3.6 km/h (1 m/s)[60];

c. once floodwater gets up to a half a metre depth, then larger vehicles the size of Holden Commodores start to become unsafe[61];

d. floodwaters at about 1.0 m depth and travelling at about 1m/sec would be enough to move a large four wheel drive[62];

e. floodwater travelling at 1.0 m/sec, at a depth of only 1.0 m would be very dangerous for people[63];

f. once flow intensities reach 1.5 m^2/sec then at only 1.0m depth it becomes a dangerous situation for *both* humans and buildings[64];

g. when floodwater travels at a velocity of 1 or 1.5 m/sec, then timber clad buildings or a brick slab on ground buildings become vulnerable to failure[65];

h. if an average person fell into flood waters 1 or 2 metres deep travelling at 7.2. km/h (2 m/s) they would have extreme difficulty saving themselves[66];

i. the best swimmers in the world can swim at about 2 m/sec in an Olympic final. The average person would find it very difficult to swim in 2 m/sec water"[67]; and

j. all building types including concrete reinforced industrial buildings are prone to failure once flood flows are greater than 2.0 m deep in combination with flow speeds greater than 7.2 km/h (2 m/s)[68].

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[59] Ex 142, page 7
[60] Ex 142, page 7
[61] T p. 1083 l. 40 - 44
[62] T p. 1084 l. 38 - 42
[63] T p. 1085 l. 8 - 9
[64] T p. 1109 l. 7 - 11
[65] T p. 1086 l. 13 - 18
[66] Ex 142, page 8
[67] T p. 1088 l 24 - 28

31. Mr Newton (WRM) commented that:[69]

a. at velocities in excess of 2.0 m/s, the stability of foundations and poles can be affected by scour. Also, grass and earth surfaces begin to scour and can become rough and unstable;

b. the velocity of floodwaters passing between buildings can produce a hazard, which may not be apparent if only the average velocity is considered. For instance, the velocity of floodwaters in a model test has risen from an average of 1 m/sec to 3 m/sec between houses;

c. vehicle instability is initially by buoyancy; and

d. at floodwater depths in excess of 2.0 m and even at low velocities, there can be damage to light-framed buildings from water pressure, flotation and debris impact.

32. The maximum peak flow intensity as depicted in the both figures 11.2 and 11.3 of exhibit 144 depict a peak flow intensity across the majority of Grantham at $2m^2$/sec or greater, and in some places greater than $4m^2$/sec.

33. Indeed, Mr Szylkarski (DHI) in response to questioning noted that *"… if it's above $2m^2$/sec, that's an extreme hazard. If you look at the impact of the different scenarios on those hazard ratings that Dr Macintosh has produced, whilst they might move around a little bit, they never really drop below that $2m^2$/sec extreme value. So, you know, okay, there might be some small changes, but it's still an extreme condition*";[70]

34. The level of flow intensity through Grantham that was a consequence of the extreme weather event was of such a magnitude to be very dangerous to both humans and buildings.

Limitations of modelling outcomes

35. Dr Macintosh explained that the primary point of interest of the model being used, has been what the peak flood level and peak velocity is[71]. To a secondary extent, he said that the model is used to determine how long does it take for water levels to develop for

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[68] Ex 142, page 7
[69] Ex 19, page 67, Figure 8.7 – Velocity and depth relationships (Source: DIPNR 2005)
[70] T p. 1363 l. 12-22
[71] T p. 1143 l. 15-19

evacuation paths and planning, but the modelling was primarily focussed towards the big picture, what the limits are[72].

36. Dr Macintosh acknowledges that all models are wrong, but some are useful with the question being how useful you can make the model[73]. He also stated that a model is not a truth machine it is only a schematisation of reality[74]. As a schematisation of reality, it is not reality and the model simplifies the flow characteristics[75]. Mr Smith makes a similar point with a slightly different focus, namely that a model is not a truth machine, it's just a tool that must be interpreted by persons with expertise[76].

37. Those comments are consistent with statements made by Mr Szylkarski that the calibration of the model shows that there are still 0.1 and 0.2 m differences, so it does not reproduce exactly the peak water levels[77]. In his opinion absolute accuracy relative to the data might be 10 to 15%[78].

38. The model depends upon the accuracy or correctness of the facts put into it and the reasonableness of the assumptions[79]. Dr Macintosh agrees that every little change made to the model has some effect[80].

39. Dr Macintosh stated that he has also undertaken the exercise of corroborating model outputs against the witness statements, telephone records, videos and photographs that were available to ensure that the model output closely reflected the accounts recorded. Dr McIntosh used accounts of witnesses to judge the accuracy of the modelling and also to get an understanding of what had occurred[81]. Through corroboration of eyewitness accounts Dr Macintosh believes he has established a tool that reflects what has been observed[82].

40. The modelling that underpins Dr Macintosh's opinions involved the input of data about the topography of the area, the removal of part only of the railway embankment (for the 'without' scenario only), the amount of rainfall received over a particular time period,

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[72] T p. 1143 l. 19-21
[73] T p. 1264 1. 29-31
[74] T p. 1264 1. 26-27
[75] T p. 1296 1. 7-11
[76] T p. 1093 l. 15-17
[77] T p. 1369 1. 41-43
[78] T p. 1383 1. 30-42
[79] T p. 1141 l. 7-11
[80] T p. 1132 l. 29-30
[81] T p. 1114 l. 10-12
[82] T p. 1143 l. 10-13

the depth of water past the Helidon gauge and an input for the 'roughness' of the area. It is also based upon the 'most likely' scenario for the quarry. If any of the inputs are incorrect, require fine tuning or the quarry 'most likely' scenario is not the most appropriate schematisation of the reality of the event then in view of Dr Macintosh's comment that every little change has some effect[83], any degree of influence of the railway embankment would likely change.

41. Whilst criticism is not made of the modelling exercise undertaken by Dr Macintosh or his interpretation of its output, the model does not reproduce exactly the events that occurred on 10 January 2011. The outputs are not absolutes. Any changes to the input data will also be likely to have some effect.

Effect of the Railway Embankment on Flooding

42. Dr Macintosh's modelling provides a schematisation of the events that occurred on 10 January 2011. As part of that exercise he has given particular attention to two man-made features of the landscape, namely a quarry and the railway embankment.

43. Dr Macintosh concluded that the flood event on 10 January 2011 occurred in the following manner:

    a. first, inundation of the lower parts of Central Grantham commenced on account of water backing up from Lockyer Creek in the manner it usually did;

    b. second, overland flows broke out from Lockyer Creek to the south-west of Central Grantham and moved rapidly towards Western Grantham, an occurrence that was unusual;

    c. third, within minutes of the above overland flow reaching Grantham, a second front of fast moving overland flow from the west of Grantham (this had broken out from the creek near Quarry Access Road) then joined the south-western flows; and

    d. at the point in time of the joining of the western and south-western flows the railway embankment was stopping all flow to the north forcing any flood water that would have otherwise travelled north, had the railway embankment

[83] T p. 1132 l. 29-30

not been present, to instead travel to the east, along with the remainder of the flows[84].

44. According to the modelling outputs, between 4.05 pm and 4.10 pm the water from the west and south-west joined[85] and by 4.20 pm the water had commenced overtopping the railway embankment[86].

45. Dr Macintosh modelled various quarry scenarios including 'most likely', 'worst case (greatest drop)', 'worst case (greatest delay)', and 'no quarry'.

46. In part 11 of exhibit 144 Dr Macintosh has undertaken an assessment of the effect of the railway embankment on flood hazard by comparing inundation plots of maximum flow intensity (depth x velocity) for the 'with' and 'without' railway embankment scenario[87]. For that exercise the modelling is based upon the 'most likely' quarry scenario[88].

47. Dr Macintosh identifies that the railway is elevated above natural ground level by an embankment that extends up to a maximum of approximately 2 m in height[89]. For the 'without' scenario Dr Macintosh, *"..removed the railway embankment by determining the natural ground levels across the width of the railway corridor. The natural ground levels were determined from topography provided by Lockyer Valley Regional Council"*[90]. Figure B-21 depicts the contour plots for the 'interpreted' natural surface of the 'without' railway scenario[91].

48. These topographical changes made to the model whilst sufficient for the present purpose were relatively simplistic in that they involved taking AHD levels from either side of the railway embankment and then averaging those levels as if the railway land was flat across that area.

49. Dr Macintosh did not remove the entire length of the railway embankment for the 'without' exercise, rather his objective was to identify if there *'was an impact'* and so

[84] Ex 144 pages 21 to 22 para 10
[85] Ex 144 page 85 figure 9.2 (e) and (f)
[86] Ex 144 page 85 figure 9.2 (h)
[87] Ex 144 page 121 para 406
[88] Ex 144 page 32 para 54
[89] Ex 144 page 121 para 404
[90] Ex 144 page 121 para 406
[91] Ex 144 page 204 figure B-21

he drilled down to the simplest situation[92]. Figure 11.1[93] identifies the extent of the railway embankment removed for the 'without' railway embankment scenario[94].

50. Figures 11.2 and 11.3 represent the peak flow intensity derived from the modelling exercise for the 'with' and 'without' scenarios respectively[95]. Figure 11.4 represents the increase in peak flow intensity in the 'without' scenario[96]. Exhibit 160 represents the difference in maximum depth in the 'without' scenario. The majority of the residential part of Grantham falls with zero to 0.2 of a metre. Exhibit 161 (sheet 1) represents the difference in velocity flows in the without scenario. The maximum change in velocity is 0.4 m/sec.

51. Ex 161 sheet 3 shows the maximum peak velocity contour without the railway embankment in place[97]. The high points of the contour are on the railway line itself[98]. The effect of the railway embankment on velocity reduces as you move south away from the embankment[99].

52. Dr Macintosh considers that the effect of the railway embankment on flood characteristics would be to intercept the flow of inundating flood waters that would have otherwise moved unrestricted into the Sandy Creek floodplain area to the north of the embankment[100]. Dr Macintosh formed the view that the result of the interception was to intensify the action of flood flows within Western Grantham in the early stages of the flood by:

    a. directing incoming flood flows from both the south-western overbank flow path and the western grantham flow path to an easterly direction, but a greater depth and flow intensity than would have otherwise have been the case had the embankment not been there; and

    b. creating a concentration of flood flow to the northern side of the embankment at the location of the Sandy Creek rail bridge crossing[101].

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[92] T p. 1172 l. 28-30
[93] Ex 144 page 121
[94] T p. 1226 l. 43-44
[95] Ex 144 page 122
[96] Ex 144 page 123
[97] T p. 1316 1 32-35
[98] T p. 1316 1. 44-45
[99] T p. 1317 1. 43-45
[100] Ex 144 page 123 para 409
[101] Ex 144 page 123 para 409

53. Dr Macintosh observes from Figure 11.4 that the railway embankment increases peak flood flow intensities through Western Grantham and Central Grantham to the west of Sandy Creek[102]. He says that the magnitude of the increase in flow intensity is relatively consistent throughout this area, typically by around an additional 0.5 m^2/sec[103]. Near the rail bridge the increase ranges up to an additional 2.5 m^2/sec[104].

54. When Dr Macintosh was asked the following question , *"Although that intense water in the centre of Grantham appears in both cases in any case"* he answered *"Yes, it's in the early stages it's not there, but as the event develops towards the maximum in both scenarios it's extremely high the intensities"*[105].

55. Dr McIntosh expects that the removal from the model of a further section of the railway embankment to the west would have reduced the intensity of the water that proceeded in an easterly direction towards Grantham[106] and guestimates the difference in the order of 0.1 m[107].

56. Despite the interpretation of the model outputs as to the difference in intensity, as noted above Dr Macintosh stated that as the event developed towards the maximum in both scenarios the intensity is extremely high[108].

57. Dr Macintosh was very clear that in comparing the 'with' and 'without' railway embankment scenarios he was not suggesting that the railway embankment caused the flood[109]. In response to a question he stated, "*Looking at the flow intensities, there's a notable change in the maximums, but with regard to translating that into causes of damages the intensities are so high that the consequences would be unaffected, I would say...*"[110].

58. In answer to a question, Dr Macintosh unequivocally stated that in the event that a similar rainfall event occurred in the catchment with a similar level of saturation that

[102] Ex 144 page 123 para 410
[103] Ex 144 page 123 para 410
[104] Ex 144 page 123 para 410
[105] T p. 1173 l. 1-4
[106] T p. 1227 l. 15-18
[107] T p. 1228 l. 8-12
[108] T p. 1173 l. 1-4 and T p. 1173 l. 5-15
[109] T p. 1173 l. 5-15
[110] T p. 1173 l. 5-15

with or without the railway embankment (and quarry or no quarry) the same consequences would happen again with the same flooding characteristics[111].

59. The magnitude of the flood event of 10 January 2011 was so great that its impacts on Grantham were described by Dr Macintosh and Mr Newton as inevitable[112].

Impacts at [redacted] atton-Helidon Road

60. The house at [redacted] Gatton-Helidon Road Grantham was the home of Mr Bruce Marshall who lost his life during the flood event.

61. Before the event Mr Marshall resided with his wife and one of his sons at [redacted] Gatton-Helidon Road[113]. Mr Marshall was alone in the house when it was inundated by floodwater[114]. The Coroner found that he had drowned in the floodwaters[115]. According to the emergency phone calls made by Mr Marshall from as early as 4:11 pm, the floodwaters prevented him from leaving the house[116].

62. As part of the 'with' and 'without' railway embankment scenario Dr Macintosh extracted data from the model in relation to that property. The extracted data is presented in exhibit 161 sheets 5 to 7. Each of the graphs is based upon the 'most likely' quarry scenario.

63. Sheet 5 of exhibit 161 represents the changes in depth for the 'with' and 'without' railway embankment scenario in the middle of the house. In explaining the graph Dr Macintosh stated that it is not meaningful to discuss intensity in the middle of an object[117]. On that basis the intensity references on the right hand side of the graph ought be ignored. Dr Macintosh also stated that the levels are not a definitive statement of how much water was in Mr Marshall's house because it is an averaging of the depth of water across a 10 by 10 m grid cell[118].

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[111] T p. 1174 l. 41 – p. 1175 l. 1-10
[112] Ex 166, page 39, para 69; T p. 1174 l. 43to - T p. 1175 l.5
[113] Shirley Jean Marshall – Ex 168.4
[114] Transcript of '000' Emergency Call at 10 January 2011 at 16:12; Shirley Jean Marshall – Ex 168.4; Fiona Elizabeth Latz – Ex 168.2 at [14]
[115] Page 58 of the Queensland Coroner's '*Findings of the inquest into the January 2011 SEQ flood deaths*', which formed part of annexure 'D' to the Grantham Floods Commission of Inquiry's letter of instruction to Dr Macintosh dated 3 August 2015.
[116] Transcript of '000' emergency call on 10/01/2011 at 16:11; Transcript of '000' emergency call on 10/11/2011 at 16:12; Transcript of '000' emergency call on 10/01/2011 at 16:18
[117] T p. 1319 1. 19-21
[118] T p. 1319 1. 23-28

64. With reference to Figure 13.6[119] (which includes some of the same data as exhibit 161 sheet 5) Dr Macintosh made the following observations. The change is based on the average over the 10 m grid[120]. It is not necessarily an accurate representation of the precise difference at a particular point as there is a range of the grid size within which it sits[121]. If it were modelled on a 1m grid it would be more precise as to exactly what the change is[122]. Without the railway embankment the modelling shows the average depth may have been about 0.3 or 0.4 metres lower[123]. The calculation however does not tell the height of water in the house or how it was flowing (including its velocity) within the house[124]. It only shows that on a 10m x 10 m grid the change in average height across the grid[125]. In any event, the evidence of velocities in that vicinity show that they were dangerous and extreme regardless of the railway embankment[126].

65. Sheet 6 of exhibit 161 represents levels to the northern side of the house and within the yard[127]. In the 'most likely' quarry scenario and 'with' the railway embankment the depth is about 2.6 metres[128] and 'without' the embankment about 2.2 metres[129]. The velocity without the railway embankment is a bit less than 1 m/sec[130]. In either case the water is over a person's head[131] and within Mr Smith's danger zone[132]. Inside the house the water could be higher or lower than the average[133].

66. Dr Macintosh points out that the schematisation of the house has been undertaken to establish the house's impact on the flooding surrounding the house, the modelling has not been at all focussed on modelling of what has happened inside the house[134].

67. Sheet 7 of exhibit 161 represents levels at the southern side of the house on this property[135]. Dr Macintosh stated that at 4.18pm:

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[119] Ex 144 page 155 Simulated Flow Characteristics of Mr Marshall's house (Location D)
[120] T p. 1306 1. 5-6
[121] T p. 1306 1. 8-10
[122] T p. 1306 1. 12-14
[123] T p. 1308 1. 25-27
[124] T p. 1308 1 29-33
[125] T p. 1308 1. 35-36
[126] T p. 1321 1. 32-33
[127] T p. 1319 1. 30-32
[128] T p. 1319 1. 40-43
[129] T p. 1319 1.45
[130] T p. 1320 1. 18-19
[131] T p. 1320 1. 23-24 and 1. 38-39
[132] T p. 1320 1. 26
[133] T p 1320 1. 33-35 and p. 1321 1. 1-4
[134] T p. 1320 1. 39-43
[135] T p. 1321 1. 19-21

a. either 'with' or 'without' the railway embankment the situation would be an extreme hazard for any person[136]; and

b. it would have been too dangerous to leave the house in either scenario[137].

68. In light of Dr Macintosh's opinion about the level of hazard at the property, Mr Marshall was in a situation that was an extreme hazard for any person, irrespective of his personal circumstances[138].

Conclusion

69. The railway line has been in its current location for well over 100 years.

70. The 10 January 2011 flood was caused by an extreme natural event. It was exceptionally large, rapidly developing and extremely hazardous. The magnitude of the event was such that the impacts on Grantham were inevitable irrespective of the railway line.

71. With specific reference to Terms of Reference (a), the flooding of the Lockyer Creek between Helidon and Grantham on 10 January 2011 was not materially altered or contributed to by the railway line.

Ms J.S. Brien
Counsel for Queensland Rail

28 August 2015

[136] T p. 1321 1. 32-33
[137] T p. 1321 1. 8-10
[138] Shirley Jean Marshall – Ex 168.5 at [3], [5] to [10]