BRIDGE OVER HAWKESBURY RIVER AT WINDSOR **GRAPHITISATION OF CAST IRON PIERS**

CTI Consultants' report of 1 July 2011; References:

Commercial Diving Solutions report of 15 June, 2011.

(These reports relate to site activities at the Bridge Site on 9 to 21 May

2011).

Attachments: (1) Table 1, page 9 of CTI report entitled 'Summary of Core Samples (2005 and 2011)': (2005 and 2011)';

(2) Bed Level Depths at piles (page 13 of CDS report): Mr. Ruy WEDGWOO

(3) Page 24 of CDS report (Pier 5 U/S pile);

(4) Page 30 of CDS report (Pier 5 D/S pile);

(5) Page 36 of CDS report (Pier 6 D/S pile).

Helin Hong Date: 7 15/2018 plyed to publish Yes / No

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Graphitisation of the cast iron piers at Windsor Bridge is a chemical transformation of carbon to graphite resulting from the immersion in or contact with "polluted water" of the cast iron tube piles in the piers. This phenomenon results in a loss of cross section and therefore strength. There are two piles at each pier position. The water into which the piles were established has been tested and can be described as standard soft water with no saline contentioning Sulctions report of the June, 2013

Graphitisation is a phenomenon that can result in severe deterioration of cast iron sewer pipes at elevated temperatures, but is very slow acting in the benign conditions at Windsor. In addition, the graphite formed usually provides protection to the cast iron underneath.

7. Signerior to take to site estimates at this Bridge Site on 9 to 24 May

The degree of graphitisation has been measured by taking core samples from the walls of the cast iron pile cylinders. The cylinders were manufactured pre-metrics to Imperial Units; the nominal wall thickness would have been one inch (25.4mm).

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For sections "below water", core boring results are listed in Attachment 1. There are two columns of results, the first being Casting Length, i.e. which refers to the original wall thickness of each cylinder, and the second being Residual Cast Iron The difference between the two is the loss of wall thickness from graphitisation. The average of the first column is 24mm while the average of the second column is 16mm; the difference being 8mm, which is the average loss over 444 years of pier cylinder life. The last we have convenient

After being sunk into position through bedrock, the cast iron cylinders were filled with a core of concrete inca surround of bricks, which enhances and adds to their load carrying capacity. Thus the loss of one third or more of the cylinder wall thickness would only result in a minimal reduction in the strength of the piers. This loss of cylinder wall thickness is equivalent to one mm in 18 years of the pier life. Throughton has tode measure

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or to, one remined well thickness would to the best c

the contract that a mineral respection in the contract of the first of the party of In the records of Attachment 1 there are two low readings for samples from Pier 5. These are:

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- i) Upstream pile, NW, 6-10mm @ 0.7m below water level, i.e. loss of 15 -19mm;
- ii) Upstream pile, SW, 2-9mm @ 0.7m below water level, i.e. loss of 16-23mm.

are reported for the state of the form of the contract of the state of

Whilst these results are worrying, they should not cause the panic obviously felt by inexperienced RMS Project Managers, as the cylinders now have a competent infill, which substantially adds to their strength.

There are also two readings in the "Casting Length" column of 38mm (Piers 7 and 9), most likely as a result of a supply issue. (38mm being the metric equivalent of one and a half inches).

It will be noted that for the six "above water" samples and the first "below water" sample (which is actually above water) there has been no graphitisation loss. One sample is 35mm thick, most likely because of a supply issue. The remaining above water samples are 26, 27, 23, 25, 26 and 25mm, with an average length (wall thickness) of 25.1mm. Thus there has been negligible loss from this sample group.

It appears that the higher losses occur within the 1m range of water depth, suggesting that turbulence in the surface water may be a contributing factor to the loss.

Attachment 2 is a schedule of bed level depths measured from the datum point. With the exception of Piers 1 and 10 (which have negligible water depths), the average water depth is 6.5m for Piers 2 and 9 and 7m to 8m for the remaining Piers.

We propose that a skin of mild steel half rounds be clamped around each cylinder between bed level to above water level. The half cylinders would be welded along joint lines (vertically and horizontally) out of the water before insertion and have external vertical flanges for jointing by bolts to form a protective cover. e not on that was a word. Tarbase eachair sech hims and the environable a case

Initially, the existing cylinders would be cleaned by high pressure water blasting. The cracks illustrated in Attachments 3, 4 and 5 would be protected by the skin of steel proposed above after treatment by an approved filler. Weach component of the skin would extend from bed level to above water level,, with the top section located to finish at a constant height above the high tide water level, for both practical and aesthetic of his picke, lesses death within the (M) The control of the perfect water may be a control of the control of the

Finally, we suggest that the plate thickness would be within the range 16mm to 20mm. It is envisaged that the proposal outlined above would provide protection to the piles for at least another century and All (which have negligible water depose) the accompa

Former Chief Engineer (Bridges)

The half committee as accommission leader. The half cylinders would be well-in bloom

Brian Pearson*. 3-1 for a Years 2 and 7m (Ray Wedgwood*amerg Prema Former Chief Bridge Engineer DMR (now RMS) a stand of shall sured half rouDMR/RTAI (now RMS) and each cylinder

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*With a combined experience of over 80 years in the investigation, design, construction, maintenance and management of NSW's bridges.

more the job jet this to hook a would be displace by high pressure wells, buts or the company of the expects results 3, 4 and 5 were the greater of by the st

ATTACHMENT 1 SCHEDULE OF CORE SAMPLES (2005 AND 2011)



Graphilisellon Investigation Project: Windsor Bridge Prepared for Roads & Traffic Authority NSW

able					
			Samp		

Date Cored	Pier	Column	Aspect	Height	Casting Length	Residual Cast from	Comment
Above Water				ol Santa Inperior de la Septimbrio de Imperio			
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10/03/2005	1	Distriction of the control of the co		300mm below Range	26	26	Upper limit of immersed column sections
May 2011	5	D		Ref less 2m	25	26	Above MHWS
May 2011	- 5	V.		Refless 2m	28	23	Above MHWS
May 2011	5	ilia ba	iji Solika i	Refless 2m	25	25	Above MHWS
May 2011	ā	p.P.,	4 1 7	Ref less 2m.	26	(i (28)	Abaye MHWS
rijest baresi de				Below Wa	or 5 5		
10/03/2006 19/31/14/14/14				1600mm belaw flange		25	
11/03/2005	5	To position		Underwater	31	ii,≽20, j.	At internal thickening
11/03/2006	5	ρ	gial.jij	Underwater	≈30		1.6m from bed
11/03/2005	7	0.0	diam'r	Underwater	~ 38	18	1.6m from bed
11/03/2005	9	ů		Underwater	+38	27.19	1.8m from bed
May 2011	б	U	NW	Ref less 4m	22"	7640: v	= 0.7m below water
May 2011	6	Ü	NE	Refless 4m	24	::1415	= 0.7m below water
May 2011	5	u.	SE	Refless 4mm	24	10-11	7 m valovi valov
May 2011	5	u U	SW	Refless 4m 🕬	22-23	8-14	= 0.7m below water
May 2011	5	1.50	= SW	Refless 4m	22-23	2.	€ 0.7m below water
May 2011	5	U.	NW	Refiess 5m	22	14-17	~ 17m below water
May 2011	3	j v	NE :	Ref jess 5m	29	21-27	- 1.7m below water - 1.7m below water
11672111	5	Jav. 9	8E :	Ref Jess 5m	an Silveri	18-20	Zγγm below water
May 2011		i e e un s	877	Refless 50	5 24 1 4 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1	4624	50mm core through cack
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Bridge over Hawkesbury River at Windsor

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ATTACHMENT 2 SCHEDULE OF BED LEVELS



Indicates cleaned and inspected piles

Commercial Diving Secutions Pty Lic ABN 60 091 624 805

6 415 Windsor Bridge

Bed Level Depths from RL (Bottom Edge of caisson flange below concrete tie beam)

at piles and approx. 15m US and DS

	WINDSOR 个	
← Downstream		Upsirean >
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Bridge over Hawkesbury River at Windsor

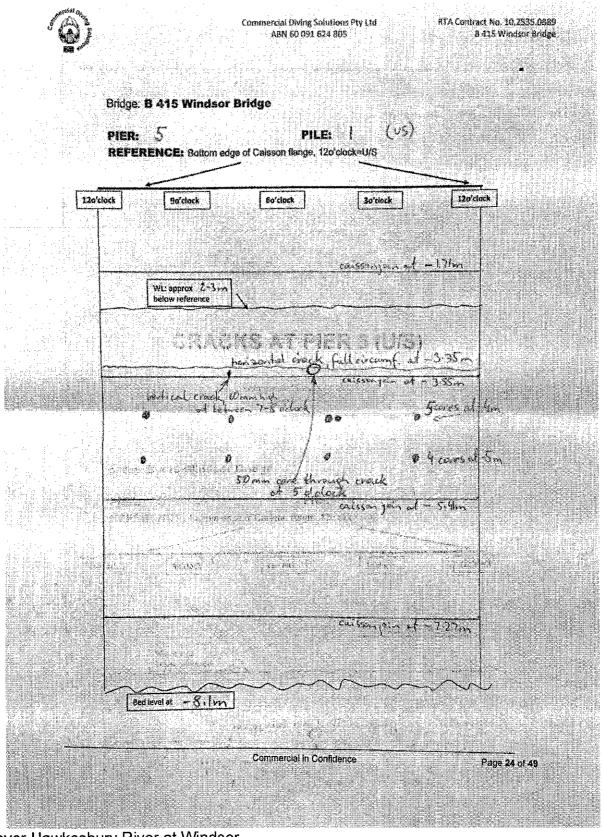
ATTACHMENT 3

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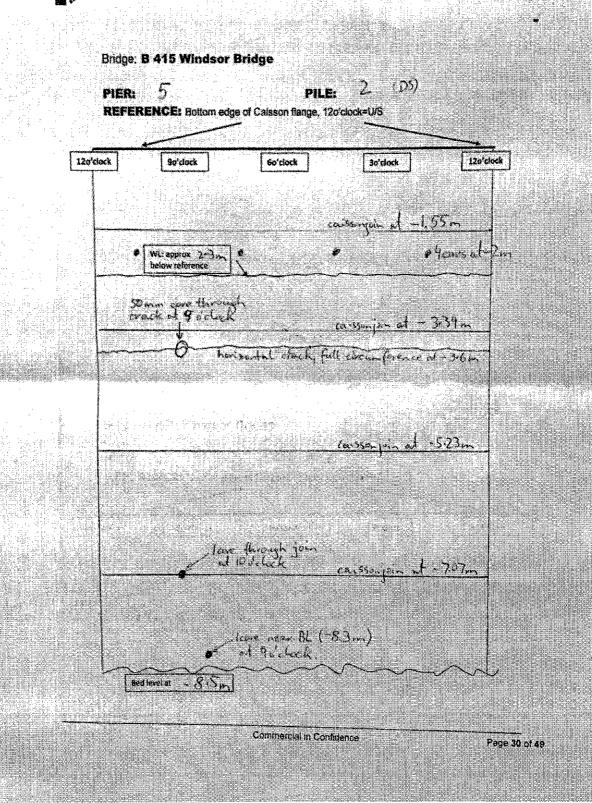
CRACKS AT PIER 5 (U/S)



Bridge over Hawkesbury River at Windsor

ATTACHMENT 4
CRACKS AT PIER 5 (D/S)





Bridge over Hawkesbury River at Windsor



Bridge: **B 415 Windsor Bridge** PILE: 2 REFERENCE: Bottom edge of Caleson flange, 120'clock=U/S 3o'clack 6a'clock 9a'clock 120 clock WL: approx below reference sed level at -7.6 m Bed level at Commercial in Confidence Page 36 of 49 Bridge over Hawkesbury River at Windsor