Structure 228 - Structural Assessment Report

MR272 & MR320 Structures Assessment

V210242

Prepared for

Bega Valley Shire Council

6 December 2021

Cardno

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Executive Summary

Cardno was engaged by Bega Valley Shire Council to undertake inspections and structural assessments of 49No. structures to determine their safe load carrying capacities for heavy vehicles. The objective is to enable decisions to be made regarding the safe carrying capacity of these structures, enabling a variety of heavy vehicles to safely utilise the route.

The two roads forming the work site total 82km in length, all of which is sealed and forms part of the Main Road (MR) network in Bega Valley area. These roads are Council's responsibility to maintain and manage safely. The two roads are:

- 16.3km of MR320, Cobargo Bermagui Road, from the intersection with the Princess Highway at Cobargo to the intersection with MR272, Wallaga Lake Road, north of Bermagui.
- 65.7km of MR272, from Carp Street, via Tathra and Bermagui to the intersection with MR320 Cobargo Bermagui Road.

The safe carrying capacity of the structures on these routes is not well understood at present. There is a wide variety of both structure forms and heavy vehicle combinations which may use the route, particularly if there are closures of the Princess Highway between Cobargo and Bega. The assessments would identify where deficiencies exist and allow these to be addressed in a strategic manner.

The 49No. structures comprise:

- 2No. causeways with low flow structures
- 32No. culverts (box or pipe structures)
- 3No. steel corrugated structures
- 9No. bridges (< 100m length)
- 3No. larger bridges (> 100m length)

This report relates to Structure No.228 (272/54.23). It is a multispan bridge with a combination of steel and timber sections spanning simply between the supports. The bridge is over the Cuttagee Lake on MR 272 Bermagui to Tathra Road between Bermagui and Tathra. Cardno undertook the inspection and structural assessment to assess whether the structure is safe to carry the following heavy vehicles advised by the Council:

- ✓ Special Purpose Vehciles (SPV) All Terrain Cranes: a) Tadano 4-axles @ 10t each & b) Liebherr 3-axles @ 12t each
- ✓ Over-Size & Over-Mass (OSOM): Prime Mover & Low Loader with a 35t load distributed over 4-axles
- ✓ B-Double at higher mass limit (HML) with a) 17t-axle groups & b) 22.5t tri-axle groups
- ✓ Performance Based Standards (PBS_ vehicle with a primer mover & 27t quad-axle semi-trailer

The key findings of the inspection are as follows:

- The structure was found to be in an unsatisfactory condition.
- The steel girders were found to be severely affected by the harsh marine environment. They were generally rusting with severe localised corrosion. Loss of section for both transverse beams and longitudinal girders was observed. Loss of connection between the transverse beams and longitudinal girders was also observed with the capacity of connections being reduced by 30 to 60 percent. All girders were placed in condition 3 and 4.
- The timber girders were also found to be severely impacted by the humid environment. Loss of section, and deterioration of wood were commonly observed while atleast two girders were found to have longitudinal cracks at their midspans, close to their bottom fibres, thus impacting the flexural capacity of the section greatly. All girders were placed in condition 3 and 4.
- The concrete substructure was also found to have severe defects. Cracking of structure exposing reinforcement, signs of reinforcement corrosion, water marks and discoloration of structure were observed. These structures were placed in condition 3 and 4.
- The wooden supports were found to be severely damaged and all have undergone strengthening works. The wooden columns at pier 2 and pier 1, on the Eastern side, were found to be severely damaged and need immediate attention. Their collapse may damage the wooden transom beam supporting the outer most girder resulting in the loss of the girder.

- The decking cross and longitudinal beams were found to be in satisfactory shape.
- Both abutments were also found to be in relatively better shape than the other supports.

The structural assessment was carried out based on working out the demands due to the various cases and then comparing them to the capcaity of the structural elements. The key findings of the structural assessment are as follows:

- The structure does not have the capacity to carry the loads specified in Section 3. Refer Section 4 of the report for recommendation on the proposed load limit.

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1 Structure Description

Structure No. 228 is a ten-span bridge having a combination of steel girders spans and timber girder spans. Both type of girders span freely between the piers and from the piers to the abutments. The structure is located on MR272- Bermagui-Tathra Road, over the Cuttagee Lake. Key features of the structure observed/ verified/ measured on site are as follows;

Over all deck length – 113m

Overall width – 5.05m (including kerbs)

Number of spans – 10 (4 steel girder spans, 6 timber girder spans

Number of Lanes – 1

Approximate fill on top of structure – None

Span lengths – varies from 10.66m to 12.2m

Girders per span / approximate length of girders – 04 / 10.66m to 12.2m

Bridge height – Approx 4m from top of water level

Coordinates of the structure are -36.488875 Easting and 150.0536895 Northing.

As per the design drawings provided from the client, the structure was renewed in 1934 suggesting that the bridge structure was designed and constructed prior to 1934. Refer Figure 1 for the design information shown in the design drawings.

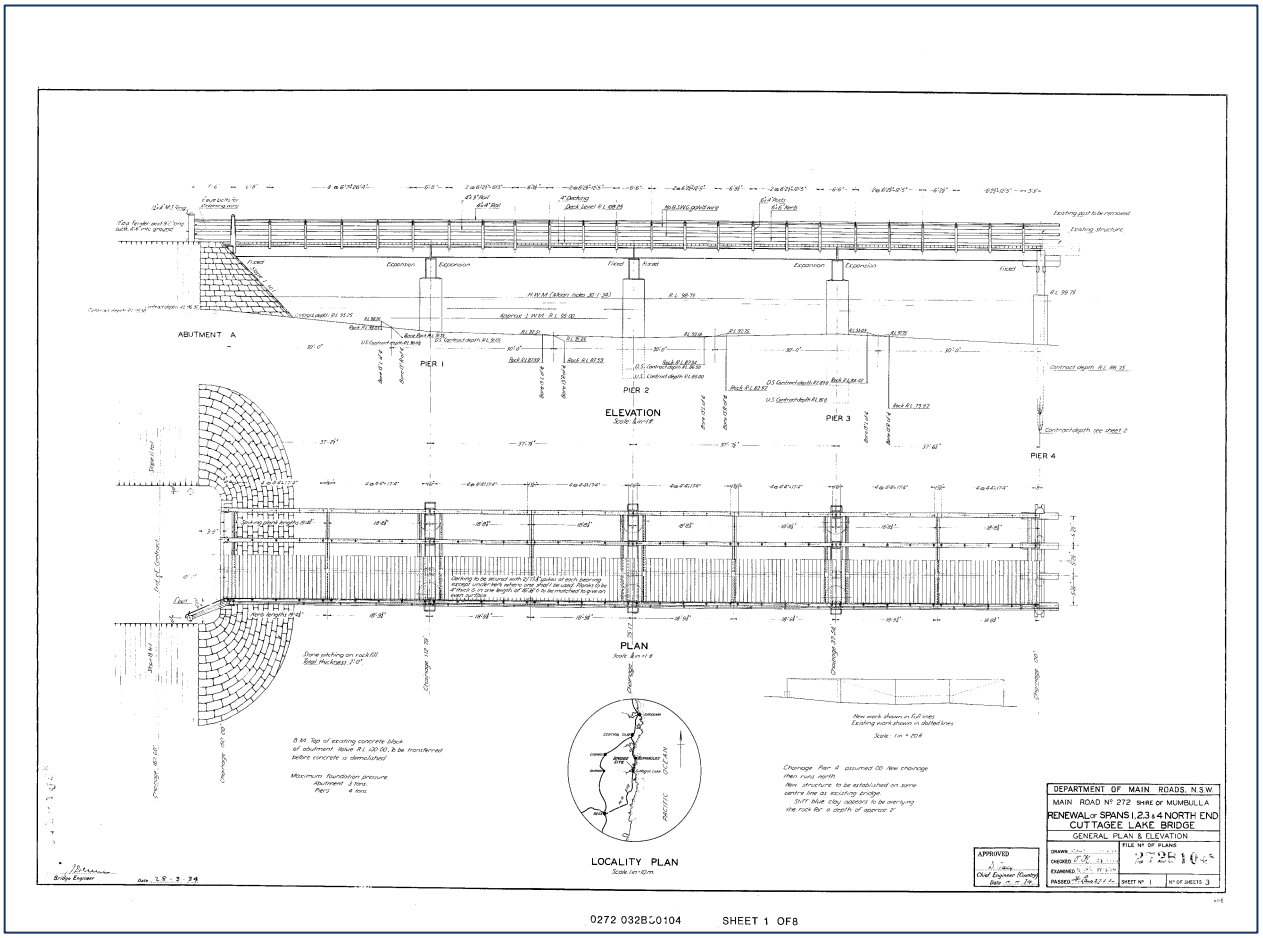


Figure 1: Original Design drawing provided for structure

2 Site Inspection & Condition Rating

The inspection took place on 10th of November 2021 and the weather during the inspections was cloudy with very light rain. The inspection was performed by two Cardno structural engineers (one senior & one junior). The scope of the inspection was limited to visual observation only. On site non-destructive testing and sampling of materials for laboratory testing was not included.

The inspection team was able to inspect all the structural elements above the lake bed level. Waders were used to get into the water and inspect each span and its components. Due to the inspection timing, water was observed under all spans of the bridge. For inspection purposes, the span towards Tathra side was considered as Span 1 and that towards Bermagui as Span 10. Refer to Figure 2 for labelling of the structure.

Figure 2: Labelling Sequence of the Structure for Inspection

Refer to Appendix A for the inspection photographs of the structure.

Following were noted from the site inspection;

1. The structure deck elements , longitudinal running board and cross planks, were observed to be in a good condition. Especially the cross planks. Longtidinal girders were mostly found to have longitudinal craks in them but were still in a satisfactory condition.
2. The last 4 span had steel I girders, interconnected with steel Channel Sections. Remaining 6 spans had timber girders. Abutment 2 and piers 7 to 9 were concrete structure whereas piers 1 to 6 and Abutment 1 were wooden structures. The wooden support piers were however all found to be strengthened with steel structures due to damage caused to them from harsh humid environment.
3. The steel girders were found to be severely affected by the harsh marine environment. They were generally rusted and severe local corrosion. Loss of section for both transverse beams and longitudinal girders was observed. Loss of connection between the transverse beams and longitudinal girders was

also observed with the capacity of connections being reduced by 30 to 60 percent. Girders of Span 1 were found to in slightly better condition than the other spans. All girders, however, were placed in condition 3 and 4 and the loss of girder section is estimated to be of the order of 20%. Refer steel girder defects photographs.

4. The timber girders were also found to be severely impacted by the humid environment. Loss of section, and deterioration of wood were commonly observed while atleast two girders were found to have longitudinal cracks at their midspans, close to their bottom fibres, thus impacting the flexural capacity of the section greatly. All girders were placed in condition 3 and 4 and the loss of section is estimated to be of the order of 25%. Refer Timber girder defects photographs.
5. The concrete substructure, piers 7 to 9, were found to have severe defects. Cracking of structure exposing reinforcement, signs of reinforcement corrosion, water marks and discoloration of structure were observed. These structures were placed in condition 3 and 4. Refer Concrete Pier defects photographs.
6. The wooden substructure / supports, piers 1 to 6, were found to be severely damaged and all have undergone strengthening works. The wooden piles at pier support 2 and pier support 1, on the Eastern side, were found to be severely damaged and need immediate attention. Their collapse may damage the wooden transom beam supporting the outermost girder resulting in the loss of the girder. The steel strengthening frames were observed to be significantly corroded as well. These structures were placed in condition 3 and 4. Refer Wooden Pier defects photographs.
7. Foundations of piers were deep and could not be inspected.
8. Abutment 1 and Abutment 2 were found to be in relatively better condition than the piers and were observed to be in condition 2.
9. The wooden railings and kerbs were found to be in satisfactory condition for now. However rusting of bolted connections and a need for reinstatement of damaged paint surface was observed

Steel Girder Defects	
Span 10 defects showing the corroded girder sections with steel showing disintegration in the form of lamination. The third and fourth photograph show the transverse members badly corroded with loss of connection. Instead of 3 bolts, 2 can be observed. Photo 5 shows loss of connection. Loss of capacity anticipated to be 20%.	

Span 7 to 9. Issues similar to Span 1 but more severe. Loss of section capacity anticipated to be min 25%.

Timber Girder Defects

Span 6. Splitting / Cracking in the second girder from the Eastern side, deterioration of section and loss of section observed for the girders in the span. The cracked girder needs immediate attention for repair to avoid catastrophe. Anticipated loss of section capacity is 30%.

Span 2. Splitting of section / Crack developing in the girder 3 from the Eastern side. Anticipated loss of section capacity is 30%.

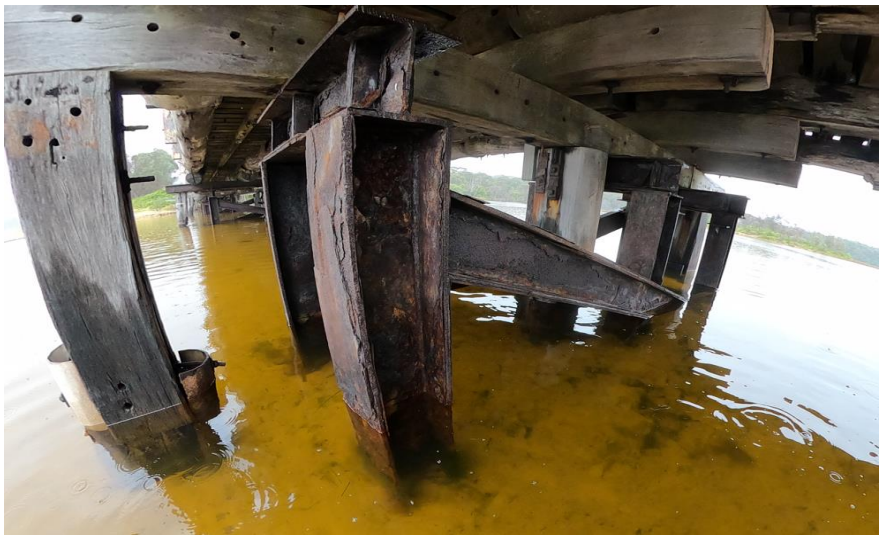
Typical defects in Timber girders of all spans. Loss of section due to deterioration of members. Anticipated loss of section capacity is 30%.

Pier Defects

Piers 7 to 9. Cracking of structure exposing reinforcement, spalling, signs of reinforcement corrosion, water marks and discoloration of structure. Severe cracking and reinforcement exposure observed in Pier 1 (first and second photo)

Pier 2 and Pier 1. Severe damage to the timber pile supporting the outer girder. Needs immediate attention to avoid localised failure of structure and possibility of loss of structure. The first photo is of Pier 2 and the second of Pier 1

Piers 1 to 6. Typical condition. The wooden structure severely damaged and strengthened using steel frames. The unprotected steel frames also found to be corroded due to humid environment and contact with saltwater.



In summary, the structure is in an unsatisfactory condition and has all the signs of progression towards failure. It is nearing the end of its useful design life and the severity of the issues and the damage occurred, suggests to replace the whole structure, super and sub structure included, with a new one. This bridge is an important link in the Shire transport system and needs attention to continue to serve the community.

2.1 Condition Rating

The site inspection and condition rating of the structure have been carried out in line in accordance with "VicRoads - Road Structure Inspection Manual 2018". Elements callout and their condition rating process (based on the defects noted during the inspection) follow these guidelines. Overall, the structure was assessed to be in an unsatisfactory condition to perform as per its intended design. Defects have been observed and mentioned in the previous section and are found to affect the performance of the elements in particular and the overall structure in general. Refer to Appendix A for the condition rating of the structure.

3 Structural Assessment

3.1 Reference Documents

The following documents and drawings have been referenced:

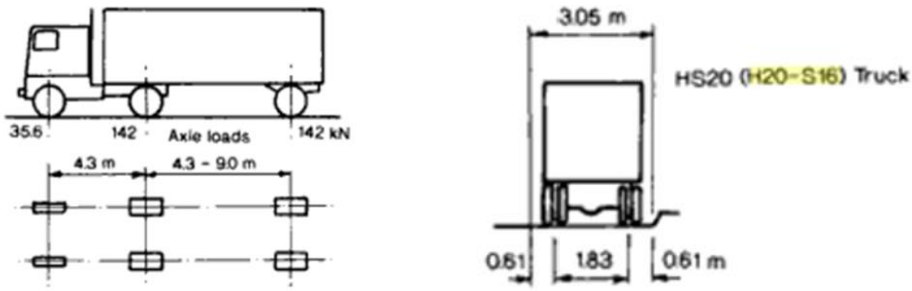
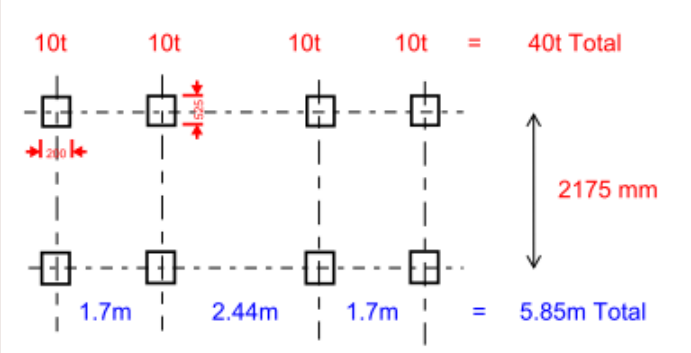
- Cardno Technical Memo V210242/MEM/001 “Proposed Tiers of Assessment for Structures”
- Cuttagee Lake Bridge Drawings – 4981-01 to 11
- Bid 228 Cuttagee Lake Bridge-Condition Scores 2017

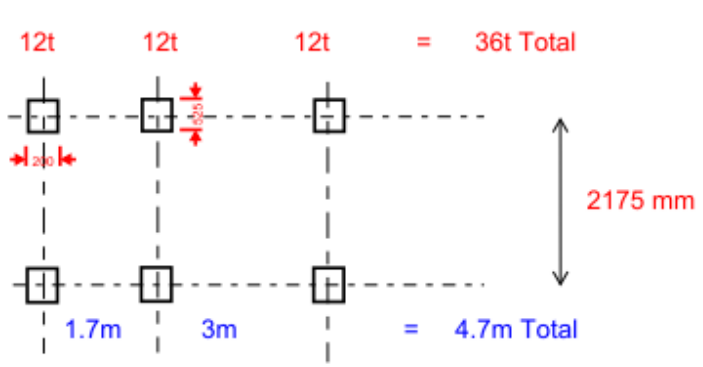
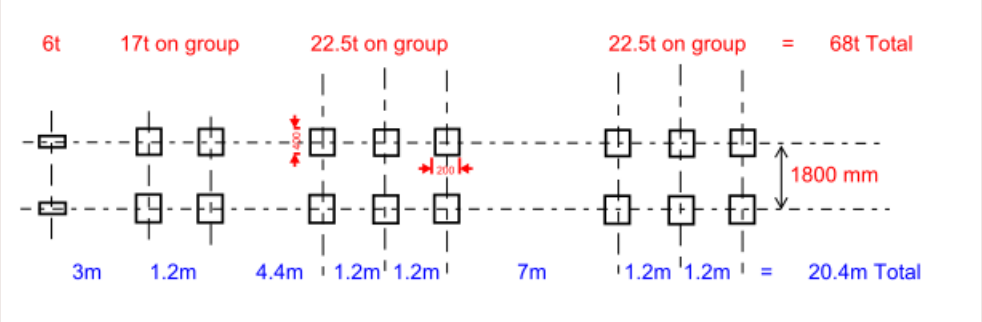
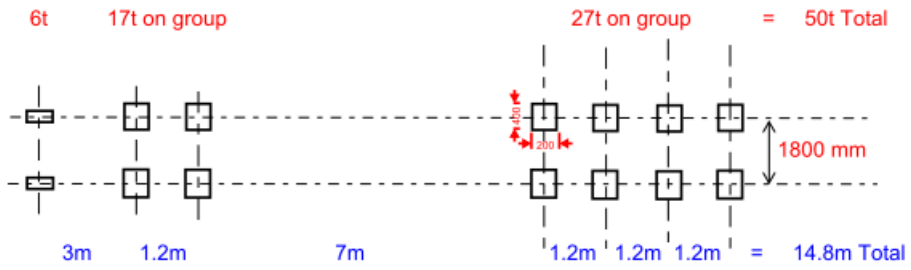
The following standards, specifications or published information will be used where appropriate in conjunction with the above information:

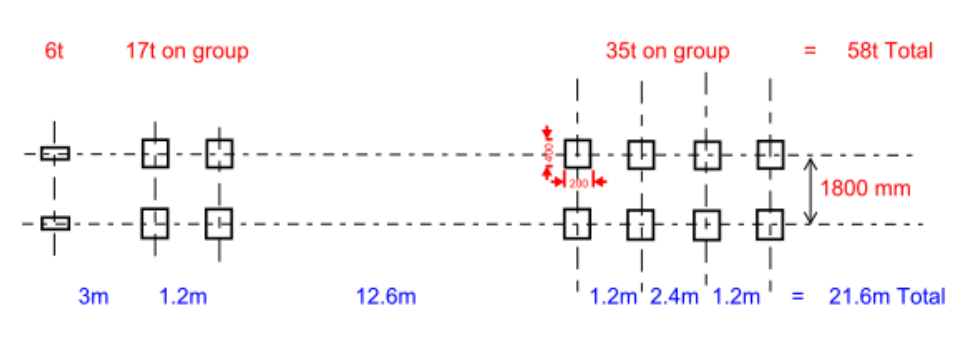
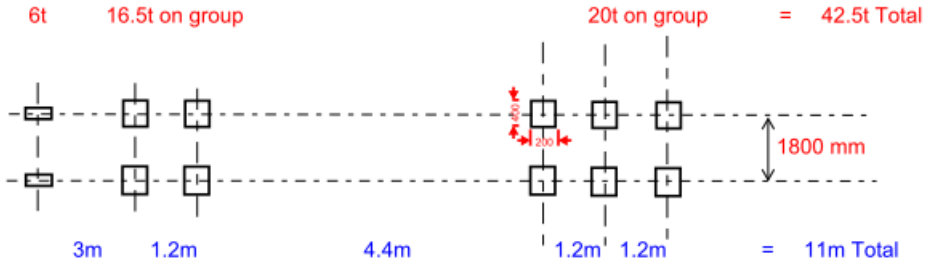
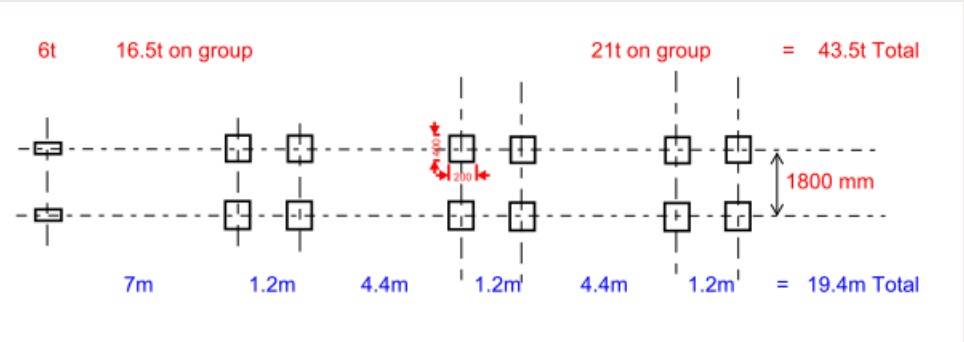
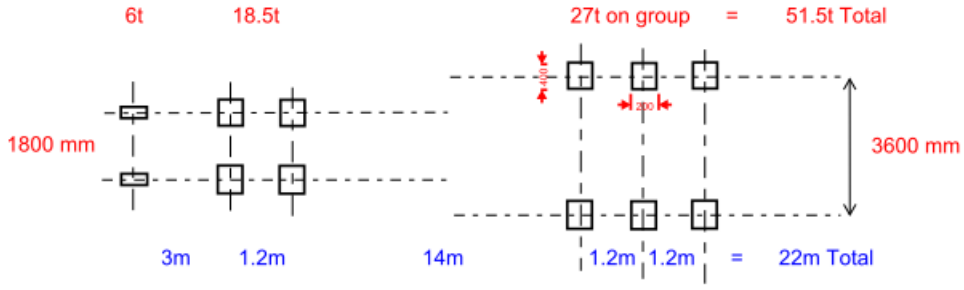
1. Austroads Research Report AP-582-18 “Higher Order Bridge Assessment in Australia”
2. AS 5100.7:2017 “Bridge Assessment”
3. Design Manual for Roads & Bridges (DMRB) BD 21/01 “The Assessment of Highway Bridges & Structures”

3.2 Assessment Loads

The bridge was assessed for the following heavy vehicle loads.

Load Case	Description
S1	H20-S16 Loading 
S2	Crane load - 4 Axles with 10t each, GVM 40t 
S3	Crane load - 3 Axles with 12t each, GVM 36t

	
S4	PBS 9 B-Double at HML with 17t Twin Axle group and 22.5t Tri-Axle groups 
S5	Prime Mover with 27t Quad Axle trailer 

S6	Prime Mover and low loader with 35t on 4 Axles (1.2m,2.4m,1.2m) GVM 60t 
S7	Prime Mover with Tri-Axle semi-trailer, GVM 42.5t 
S8	Rigid Truck with 4 Axle dog trailer, GVM 43.5t 
S9	Prime Mover and low loader 4.3m wide with 27t on 3 axles 

The structure has been designed as per H20-S16 loading and hence been designated as load case S1.

3.3 Tier 2 Assessment

Prior to the start of structure inspection phase of the project, assessment tiers for all structures were agreed with Bega Valley Shire Council as per Cardno Technical Memo V210242/MEM/001. According to this memo, the current structure was agreed to be assessed via a Tier 2 assessment. The following steps were taken to carry out the structural capacity assessment:

1. Development of a 3D model in Space Gas. Two spans were modelled. For the Timber girders arrangement, the investigations were done for a 525mm dia girder size with a span of 12.2m whereas for the Steel girders sections, a span of 11.4m was adopted. Both these spans were the maximum spans adopted from the design drawings provided by the client.
2. As per the design drawings, the steel girder section of ASB 22" x 7" x 75 lbs was considered with grade of steel equal to 250. Based on the site inspection, a 25% reduction in the capacity of sections was adopted to model the current condition of the sections.
3. The timber girders were considered to be of Grade F22, with a diameter of 525mm as per design. Based on the site inspection, a 30% reduction in the capacity of sections was adopted to model the current condition of the sections. This assumption was also verified from the Bega Valley Shire inspection of 2017. During this inspection, the main inner girders were observed to have lost section with the existing ones measuring to have diameter as less as 380mm and the condition for the girders (after loss of section) was assessed as "good". Based on a 380mm dia and F22 grade properties, the flexural capacity of the section comes out to be 266 kN-m and shear capacity as 272 kN with reduction factors of 0.9 and 0.8 respectively. This is compatible with the assumed 30% reduction of capacity for 525mm dia girder which results in 261 kN-m in flexure and 267 kN in shear.
4. The wooden planks, both longitudinal and cross planks, were modelled as 250 mm wide x 100 mm thick based on the site measurements of the existing planks. Since the planks were in relatively good condition, no loss of section was considered for them based on site inspection.
5. The model was analysed for ULS as per the capacity calculation requirements of AS 5100.7 and the maximum moment and shear were noted for the girders, for each of the respective load cases. The analysis results were then compared to the calculated reduced capacities in line with points 2 and 3. Lower values than the calculated capacities imply that the structure capacity had not been exceeded and the structure is capable of resisting the particular live load. This scenario has been represented as a "PASS". On the other hand, cases exceeding the reference capacities of the section are represented as a "FAIL".

3.4 Assessment Results and Their discussion

The assessment results are presented in the tables below with the individual +ve moment and shear effect comparison presented for both steel and wooden girders.

STEEL GIRDER ASSESSMENT BASED ON 11.4m SPAN				
Load Case	Maximum Unfactored Live Load Effects on Steel Girders		Maximum factored self-weight Effects on Steel girders	
	Moment (KN-m)	Shear (KN)	Moment (KN-m)	Shear (KN)
H20-S16	164	74	56	19
S2	206	80	56	19
S3	218	84	56	19
S4	172	76	56	19
S5	187	76	56	19
S6	213	88	56	19
S7	158	74	56	19
S8	142	67	56	19
S9	166	60	56	19

Load Case	Live Load Factor	Dynamic Load Allowance	Total max ULS live Load Effects on girder		Section capacity of Steel girders		Assessment Results based on Section capacity comparison	
			Moment (KN-m)	Shear (KN)	M (KN-m)	S (KN)	Moment	Shear
H20-S16	2.0	1.4	543.20	235.70	484.00	710.00	FAIL	PASS
S2	1.6	1.4	545.44	207.70	484.00	710.00	FAIL	PASS
S3	1.6	1.4	572.32	216.66	484.00	710.00	FAIL	PASS
S4	2.0	1.4	565.60	241.30	484.00	710.00	FAIL	PASS
S5	2.0	1.4	607.60	241.30	484.00	710.00	FAIL	PASS
S6	1.5	1.4	531.30	213.30	484.00	710.00	FAIL	PASS
S7	2.0	1.4	526.40	235.70	484.00	710.00	FAIL	PASS
S8	2.0	1.4	481.60	216.10	484.00	710.00	PASS	PASS
S9	2.0	1.4	548.80	196.50	484.00	710.00	FAIL	PASS

TIMBER GIRDER ASSESSMENT BASED ON 12.2m SPAN				
Load Case	Maximum Unfactored Live Load Effects on Timber Girders		Maximum factored self-weight Effects on Timber girders	
	Moment (KN-m)	Shear (KN)	Moment (KN-m)	Shear (KN)
H20-S16	164	45	63	12
S2	210	53	63	12
S3	218	57	63	12
S4	173	45	63	12
S5	177	45	63	12
S6	204	54	63	12
S7	158	43	63	12
S8	140	41	63	12
S9	165	45	63	12

Load Case	Live Load Factor	Dynamic Load Allowance	Total max ULS live Load Effects on girder		Section Capacity of Timber Girder		Assessment Results based on Section capacity	
			Moment (KN-m)	Shear (KN)	M (KN-m)	S (KN)	Moment	Shear
H20-S16	2.0	1.4	553.70	144.00	261.00	267.00	FAIL	PASS
S2	1.6	1.4	564.90	136.72	261.00	267.00	FAIL	PASS
S3	1.6	1.4	582.82	145.68	261.00	267.00	FAIL	PASS
S4	2.0	1.4	578.90	144.00	261.00	267.00	FAIL	PASS
S5	2.0	1.4	590.10	144.00	261.00	267.00	FAIL	PASS
S6	1.5	1.4	522.90	131.40	261.00	267.00	FAIL	PASS
S7	2.0	1.4	536.90	138.40	261.00	267.00	FAIL	PASS
S8	2.0	1.4	486.50	132.80	261.00	267.00	FAIL	PASS
S9	2.0	1.4	556.50	144.00	261.00	267.00	FAIL	PASS

Based on the ULS analysis;

1. The steel girders in the current condition, are good to take the shear induced by all the load cases including the design case, however they are deficient in flexural capacity except for the moments

induced by the load case S8. So, the only load case that can resisted be the steel girders is load case S8.

2. The timber girders in the current condition, are good to take the shear induced by all the load cases including the design case, however they are deficient in flexural capacity. Thus, they cannot resist any of the load cases specified in section 3.

3. The allowable load limit on the structure will be guided by the capacity of timber girders. Currently a load limit of 22.5 T has been specified on the bridge with a speed limit of 10 Km/h. It is recommended to reduce the limit to 15 T similar to the load configuration of S8 loading i.e. 15 T on two axles with a speed limit of 5 Km/h to reduce the dynamic impact of the loads on the structure.

4 Conclusions & Recommendations

The inspection of the structures yields the following recommendations;

- Overall the structure is in an unsatisfactory condition. It was built in 1934 or earlier and is near completion of its design life assumed to be 100 years. The low design standards of the construction era and poor condition of the super and sub-structure suggest that any upgrading / repair works of the structure may only strengthen the bridge in short term. The associated cost of replacing the whole superstructure, using the current substructure is not recommended as the substructure is also progressing towards failure. Hence replacement of the bridge is highly recommended.
- The pier and timber girder defects presented in section 2, need to be immediately addressed to avoid any damage to structure.
- The critical elements with defects presented in section 2, need to be routinely monitored to identify further deterioration of the structure.

The results of the Assessment concluded the following findings:

- The structure currently does not have the capacity to resist the load cases as defined in Section 3 of the report.
- As discussed in point 3 of section 3.4, it is recommended to reduce the load limit to 15 T similar to the load configuration of S8 loading i.e. 15 T on two axles with a speed limit of 5 Km/h to reduce the dynamic impact of the loads on the structure. This recommendation assumes that the defects presented in Section 2 are addressed / repaired. Till the time the repairs are carried out, the 15 T limit needs to be reduced to a 10T limit.

APPENDIX

A

INSPECTION RECORD

Culvert Inspection Condition Ratings Report

Bid No:	**228**	Overall length:	**113m**	metre	No. of Spans	**10**	Span length	**Refer Notes**
Road Name & No.:	**Tathra - Bermagui**	Overall width:	**5.05m**	metre	Overall Height:		ID Number	**48**
Inspection team:	**Awais Chaudry & Romnick Yndan**	**General Notes and Recommendations:** Ten span bridge with 4 spans having steel girder and the reamining 6 spans havning wooden girders. The abutment and 3 piers from Bermagui side were concrete whereas the remaining were wooden substructures strengthened with steel supports. Overall , the top corss planks and longitudinal planks of the bridge were found to be in good condition. The suuperstructure was found to be in unsatisfactory condition and the current load limit may have to be reduced. The pier supports were also found to be in an unsatisfactory condition. Overall , replacement of the complete structure is highly recommended.						
Inspection Date & Time:	**10/11/2021 , 8:00 am**							
Structure Type	**Timber + steel superstructure**							

Component	Location	Comp ID	Unit	% age of component in each condition				Summary of Defect Details and Condition - Per Component	IMG No.
				1	2	3	4		
Abutment 1	Tathra Side	24 C	m2		90	10		Concrete abutment. Had watermarks on it, discoloration and mould growth. Corrosion stains also observed on the abutment and its pile. Structurally satisfacroty for now but needs monitoring	2644
Abutment 2	Bermagui Side	24 S	m2		100			Wooden planks supporting the soil behind.with a steel frame supporting the structure infront. No visible signs of distress / damage to the steel structure and planks behind.	2780
Pier Cross Head 9		20 C	Each			70	30	Not observed to be in good condition. Cracks observed along length of the element at the top. Severe cracking at the bottom exposing the rinforcement and resulting in loss of section. Steel corrosion stains, water marks and dampness due to harsh water environment observed. Vertical crack also observed in middle of section	2653;2654;2664;2665;2666;2667
Pier Cross Head 8		20 C	Each			90	10	Not observed to be in good condition. Cracks observed along length of the element at the top. Severe cracking at the bottom of section which will promote corrosion of reinforecement . Steel corrosion stains, water marks and dampness due to harsh water environment observed.	2677;2681 to 2683;2688;2689
Pier Cross Head 7		20 C	Each			85	15	Similar to Pier Cross Head 2 but worser steel corrosion signs	2696 to 2701
Pier Column 9		22 C	Each			85	15	Cracks observed in the colmns which need to be attended repaired to avoid further damage to reinforecment. Steel corrosion stains observed at the connection of pier head and pier. Most of the pier underwater.	2653;2654;2664;2665;2666;2667
Pier Column 8		22 C	Each			100		Steel corrosion stains observed at the connection of pier head and pier. Mould growth observed. Most of the pier underwater.	2677;2681 to 2683;2688;2689
Pier Column 7		22 C	Each			100		Similar to Pier 2	2696 to 2701
Pier Structure 6		22 S / T	Each			60	40	Initial wooden frame support structure which appeared to be severely damaged and has been strengthened by means of a steel frame at some point in time. The steel structure was found to be corroded as well due to the humid environment.	2714;2716;2718;2719

Pier Structure 5		22 S / T	Each			60	40	Initial wooden frame support structure which appeared to be severely damaged and has been strengthened by means of a steel frame at some point in time. The steel structure was found to be corroded as well due to the humid environment.	2720;2722;2723;2725 to 2727
Pier Structure 4		22 S / T	Each			60	40	Similar to pier 5. The top wooden beam supporting the corbels was also found to be replaced with a steel member.	2739 to 2741
Pier Structure 3		22 S / T	Each			70	30	Similar to pier 5 but slightly better condition.	2746;2748 to 2751;2753;2754
Pier Structure 2		22 S / T	Each			40	60	Similar issue to pier 5 but worser condition. The outer most existing wooden column on the Eastern side of the structure is on the verge of collapse and will cause damage to superstructure and wooden transom supported by column. It needs urgent attention and reapir otherwise bridge structure will get irreparable damage.	2763;2764;2766;2767
Pier Structure1		22 S / T	Each			70	30	Similar to pier 5 but slightly better condition. Eatern most wooden column support beneath the girder severely damaged due to humid conditions. May need replacement / strengthening	2772;2774 to 2777;2783
Timber Corbel (4 no.)	Pier 6	7 T	Each		20	60	20	The outer most Corbels observed to have vertical cracking and need repairs. The inner corbels were in relatively better condition however had signs of vertical splitting	2714;2719;2721
Timber Corbel (4 no.)	Pier 5	7 T	Each			50	50	One circular and three square sections observed. All sections were observed to be split in the section. They need repair / monitoring to avoid for failure	2725;2732;2733
Timber Corbel (4 no.)	Pier 4	7 T	Each			40	60	All sections were observed to be split in the section. They need repair / monitoring to avoid failure	2737;2739;2743
Timber Corbel (4 no.)	Pier 3	7 T	Each			50	50	Issues similar to pier 6 but a bit better condition	2746;2755
Timber Corbel (4 no.)	Pier 2	7 T	Each			50	50	Issues similar to pier 6 . Circular section found to be of saller depth than peri 6	2761;2762;2767
Timber Corbel (4 no.)	Pier 1	7 T	Each		50	50		All sections rectangular with one section observed to have splitting whereas others observed to be in a better condition	2773;2784
Steel Girders (1 to 4)	Span 10	2 S	Each			60	40	Girders exposed and affected by harsh humid environment. Severe rusting and corrosion of sections observed. The corrosion has disintegrated of members specially the lower flanges of the girders. The transverse memebers connecting the main girders were fouud to be more affected than the longitudinal girders. Connection between the two components were also found to be failing. At most locations 1to 2 connection bolts were observed instead of the the requried 3. All transverse memebers need replacement with the main girders very easily losing their capacity by 15 to 20%.	2655 to 2663
Steel Girders (1 to 4)	Span 9	2 S	Each			40	60	Similar issues to girders of span 1. The girders were more affected and rusted. Anticipated Loss of section capacity of upto 25%. Central girders found to be more affected than the outer girders.	2668 to 2675; 2678 to 2680

Steel Girders (1 to 4)	Span 8	2 S	Each			40	60	Similar in issues and condition to Span 2	2686;2687;2691;2692; 2694;2695
Steel Girders (1 to 4)	Span 7	2 S	Each			40	60	Similar in issues and condition to Span 2	2703 to 2706;2708 to 2713
Timber girders (1 to 4)	Span 6	2 T	Each			40	60	Timber girders not in good shape. The two internal griders were found to be more deteriorated / rotten than the outer ones. Longitudial cracks and loss of section observed in the central grders. Girder capacity loss by min 30%.	2720;2722;2723;2725 to 2727
Timber girders (1 to 4)	Span 5	2 T	Each			50	50	Issues similar to Span 5. Gierders 1,3 and 4 (from the Eastern side) found to be in better condition than girders of span 5 however girder 2 was found to be severly deteriorated throughout its length. Bottom of girders were also observed to be shaved off near the corbels, significantly reducing the girder capacity	2736;2737;2738;2739
Timber Girders (1 to 4)	Span 4	2 T	Each			40	60	Timber girders not in good shape. The two internal griders were found to be more deteriorated / rotten than the inner outer. Loss of section observed in the central girders. Girder capacity loss by min 30%.	2743;2744;2745;2747; 2752
Timber girders (1 to 4)	Span 3	2 T	Each			65	35	Girder issue similar to Span 7. However girders were in a bit better condition. Internal girders more affected and deteriorated than the external girders	2755;2756;2759; 2760;2761;2762
Timber girders (1 to 4)	Span 2	2 T	Each			40	60	Timber girders not in good shape. The two internal griders were found to be more deteriorated / rotten than the inner outer. Loss of section observed in the central girders. Girder capacity loss by min 30%.	2768;2769;2770;2771; 2773
Timber girders (1 to 4)	Span 1	2 T	Each			80	20	Girders were found to be relatively in the best of shapes comapred to the other span girders. However deterioration was observed and loss of section capacity of upto 10% may be applicable.	2778;2779;2781;2784; 2785
Crossbeams/floor beams whole bridge	Span 1 to 10	9 T	Each	70	30			Cross beams in good condition. No damge / defects observed. Appeared to be relatively new than the bridge structure and may have been replaced within the past few years. Conservatively assumed to be in condition 2	Refer girder span photos
Bridge railing/Barriers	West	51 T	Lin m		70	30		Connecitons observed to be mostly rusty with rust stains on the handrail columns. Condition of the ler and wooden handrail satisfactory however need to maintenance / require painting to avoid worsening of the components	
Bridge railing/Barriers	East	51 T	Lin m		70	30		Connecitons observed to be mostly rusty with rust stains on the handrail columns. Condition of the ler and wooden handrail satisfactory however need to maintenance / require painting to avoid worsening of the components	
Wing walls 2	Bermagui Side	63 C	Each		90	10		Similar to Abutment 1 condition	2644
Wing walls 1	Tathra Side	63 C	Each					Not visible due to dense vegetation growth	

Longitudinal planks	Whole Bridge	10 T	m2		50	50		Mostly in satisfactory condition with planks properly fixed to the wooden cross planks. However planks were observed to have cracking along their lengths along whole bridge length. A gap between the western kerb and longitudinal planks was observed along the whole length of the bridge.	

Notes:

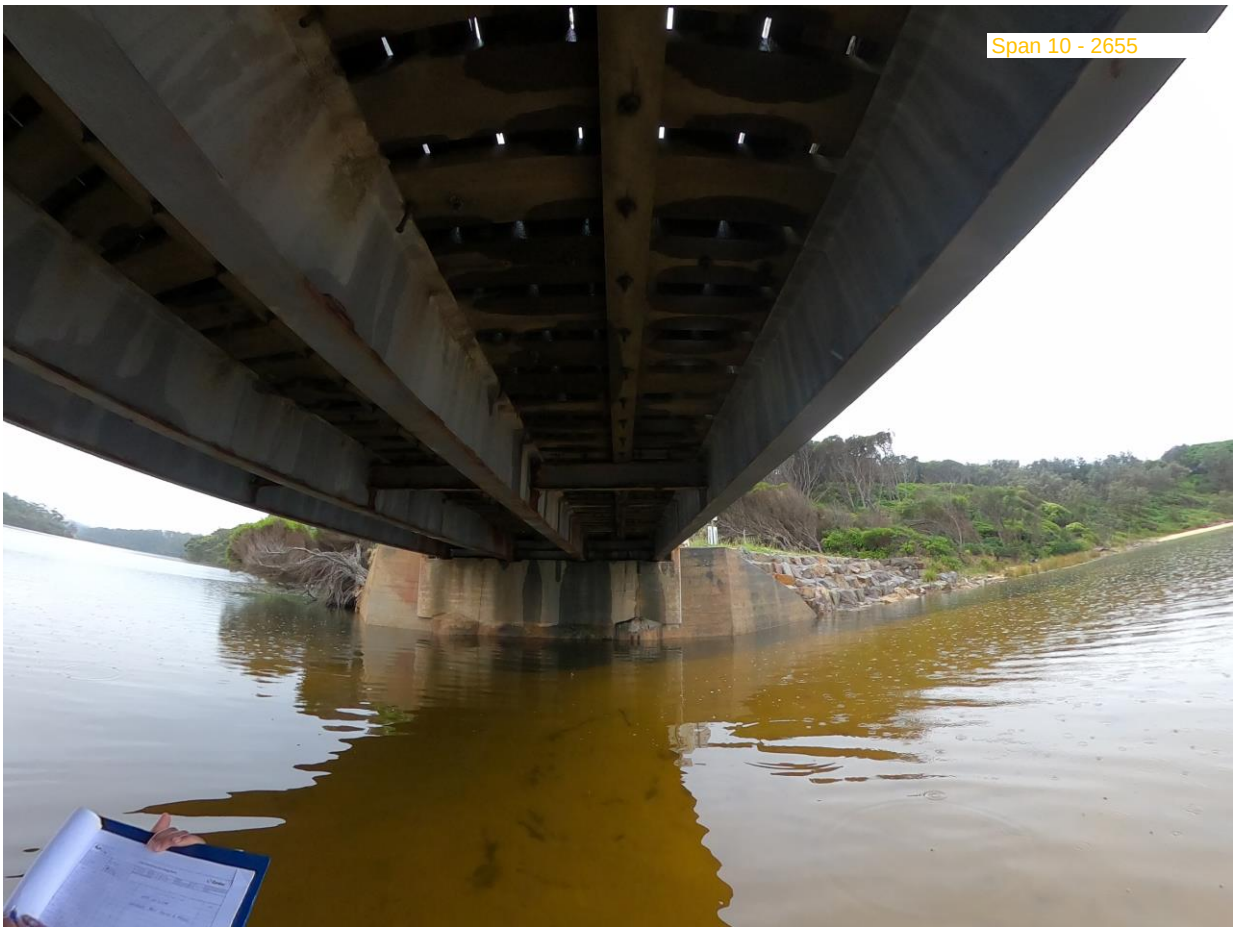
Span 1= 11.4m Span 2 = 11.4m Span 3 = 11.4m Span 4 = 11.4m Span 5= 10.66m Span 6= 12.2m Span 7 = 12.2m Span 8 = 10.66m Span 9 = 10.66m

Bridge width = 5.05m

Span 10 = 10.66m


Abutment 2 - 2644


Abutment 1 - 2780


Span 10 - 2655


Span 10 - 2656


Span 10 - 2657


Span 10 - 2658


Span 10 - 2659


Span 10 - 2661


Span 10 - 2662


Span 10 - 2663


Pier 9 -2653


Pier 9 -2654


Pier 9 -2664


Pier 9 -2665


Pier 9 -2666


Pier 9 -2667

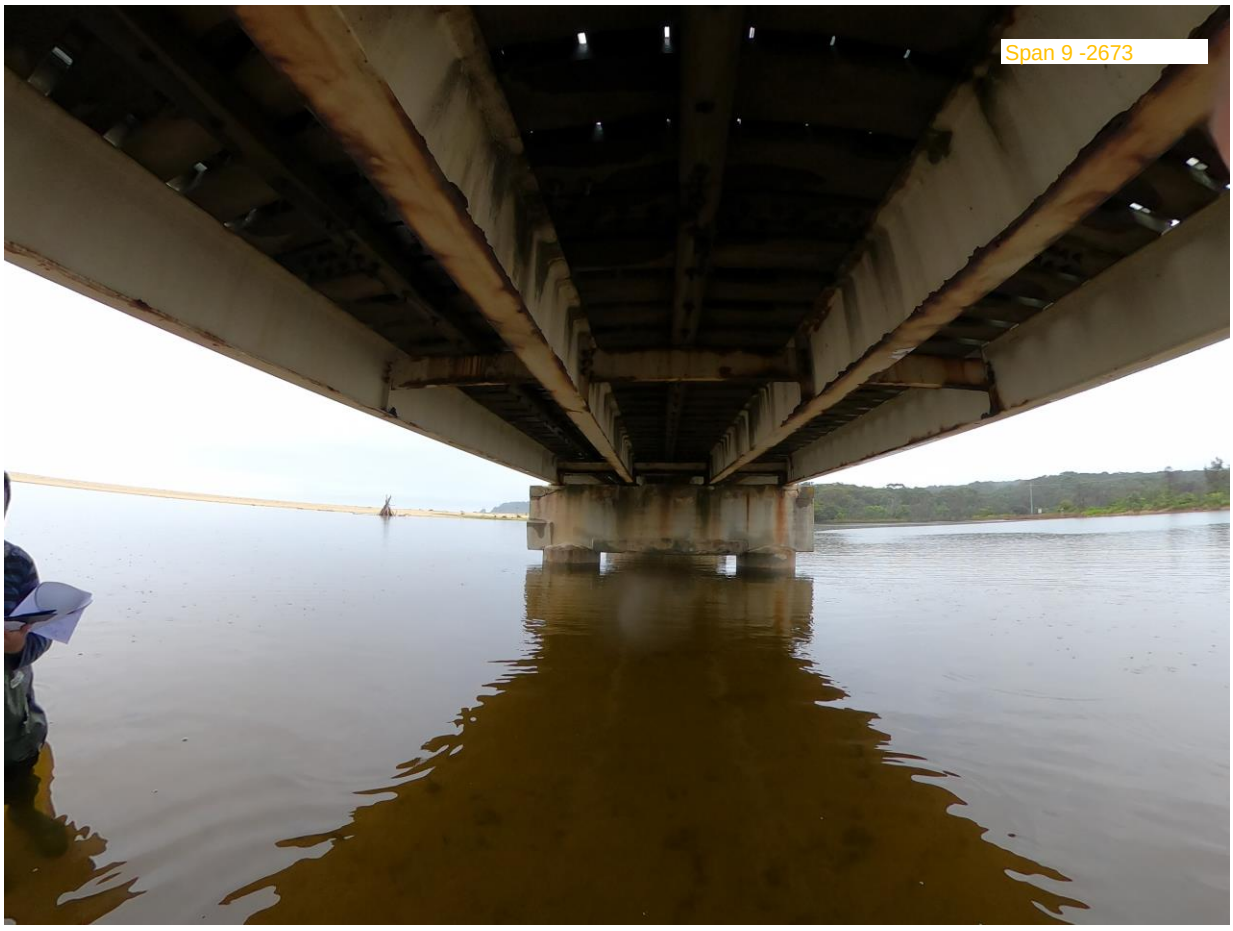

Span 9 -2668


Span 9 -2669


Span 9 -2670


Span 9 -2671


Span 9 -2672


Span 9 -2673


Span 9 -2674


Span 9 -2675


Pier 8 - 2677


Pier 8 - 2681


Pier 8 - 2682


Pier 8 - 2683


Pier 8 - 2686


Pier 8 - 2688

Pier 8 - 2689

Span 8 - 2686


Span 8 - 2687


Span 8 - 2691


Span 8 - 2692


Span 8 - 2694


Span 8 - 2695


Pier 7 - 2696


Pier 7 - 2697


Pier 7 - 2698


Pier 7 - 2699


Pier 7 - 2700


Pier 7 - 2701


Span 7 - 2703

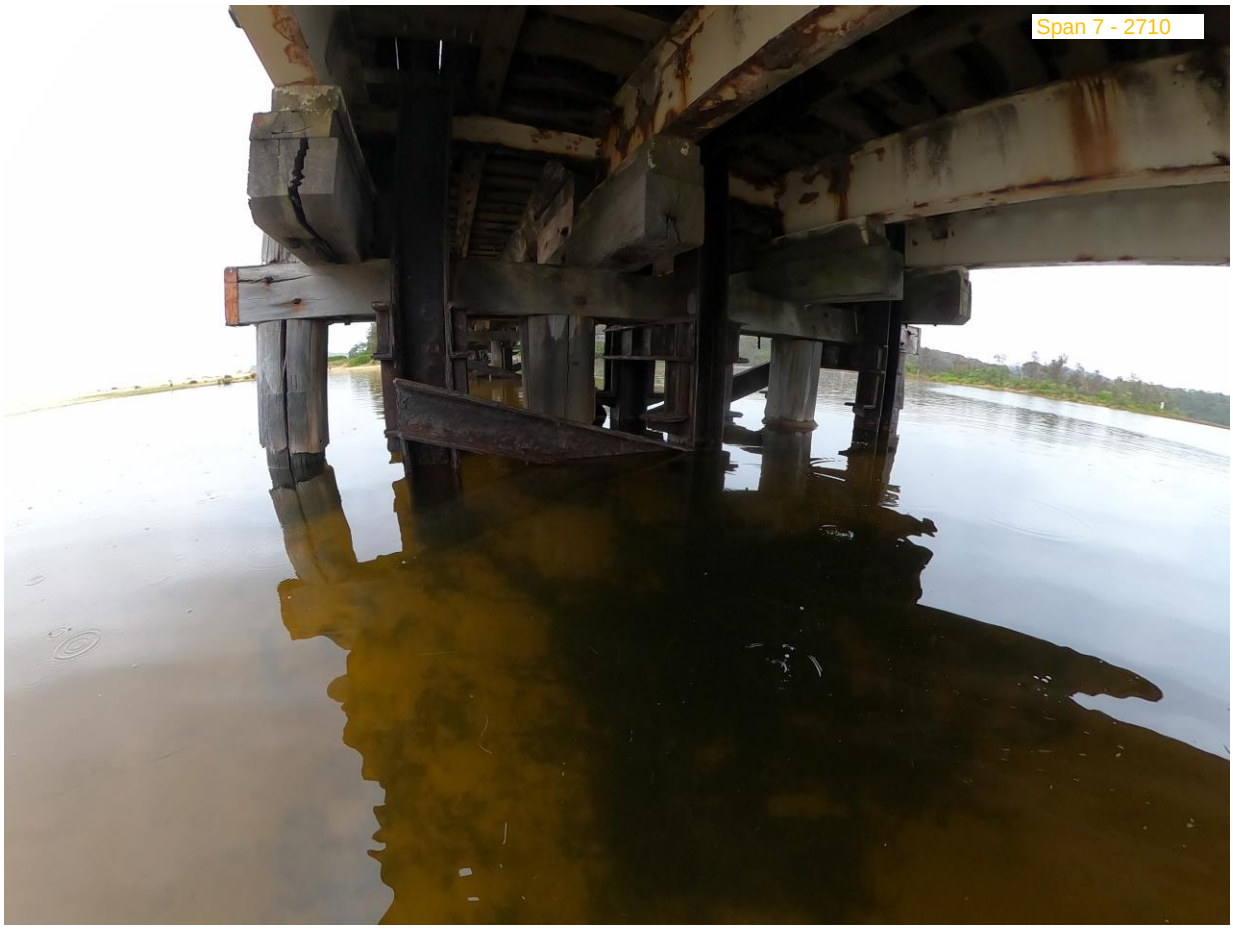

Span 7 - 2704


Span 7 - 2705


Span 7 - 2706


Span 7 - 2708


Span 7 - 2709


Span 7 - 2710

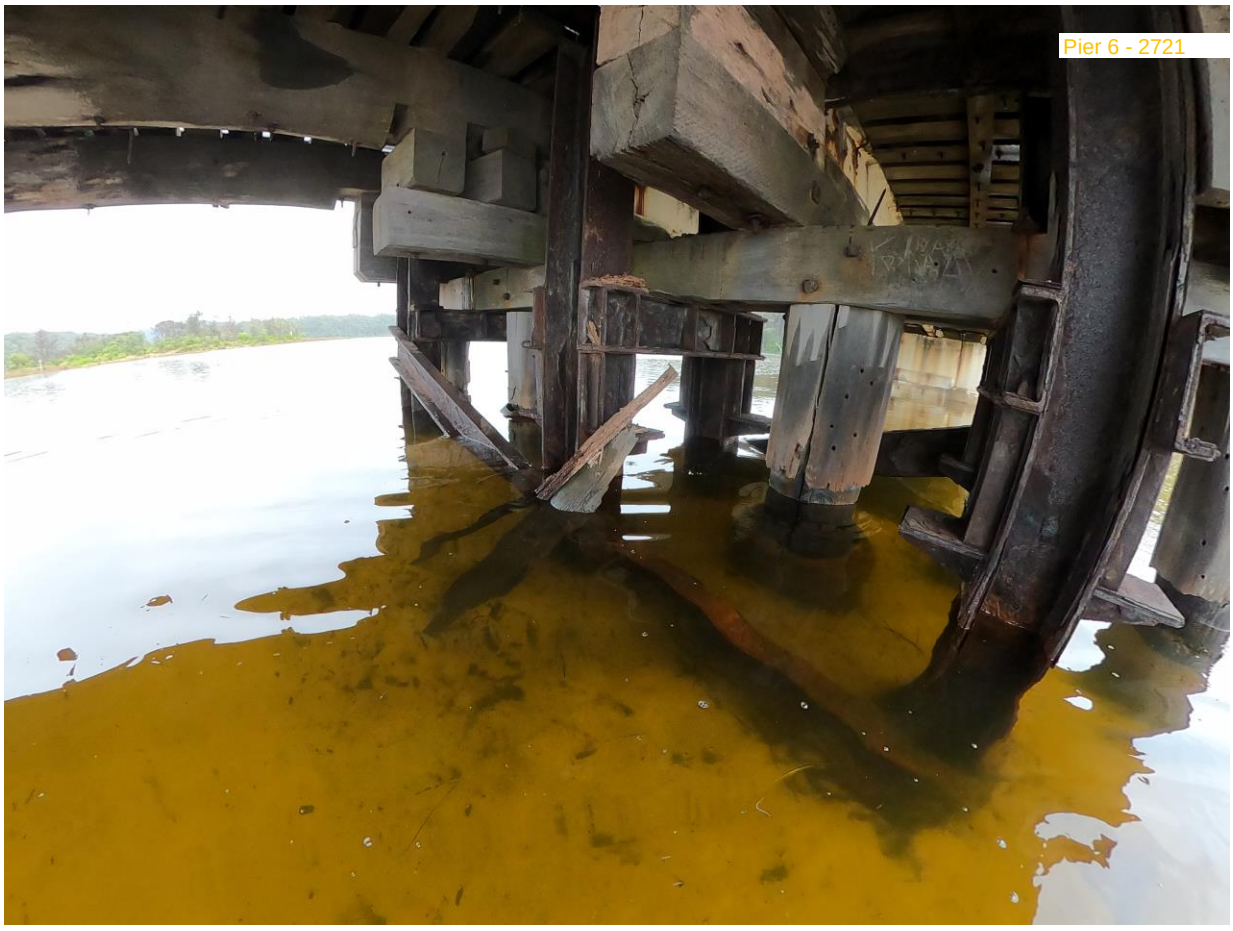

Span 7 - 2711


Span 7 - 2712


Span 7 - 2713


Pier 6 - 2714


Pier 6 - 2719

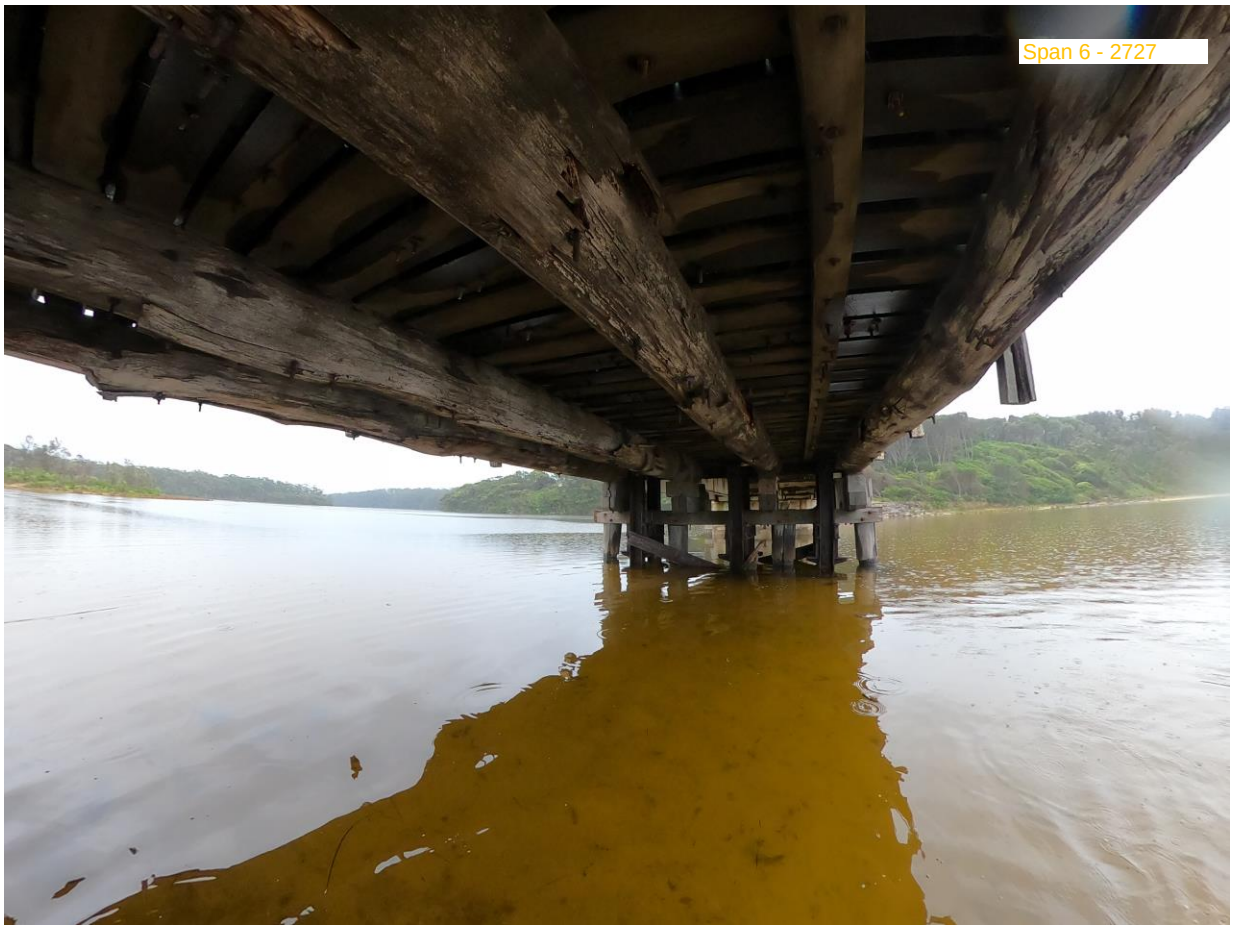

Pier 6 - 2721


Span 6 - 2720


Span 6 - 2722


Span 6 - 2723


Span 6 - 2726

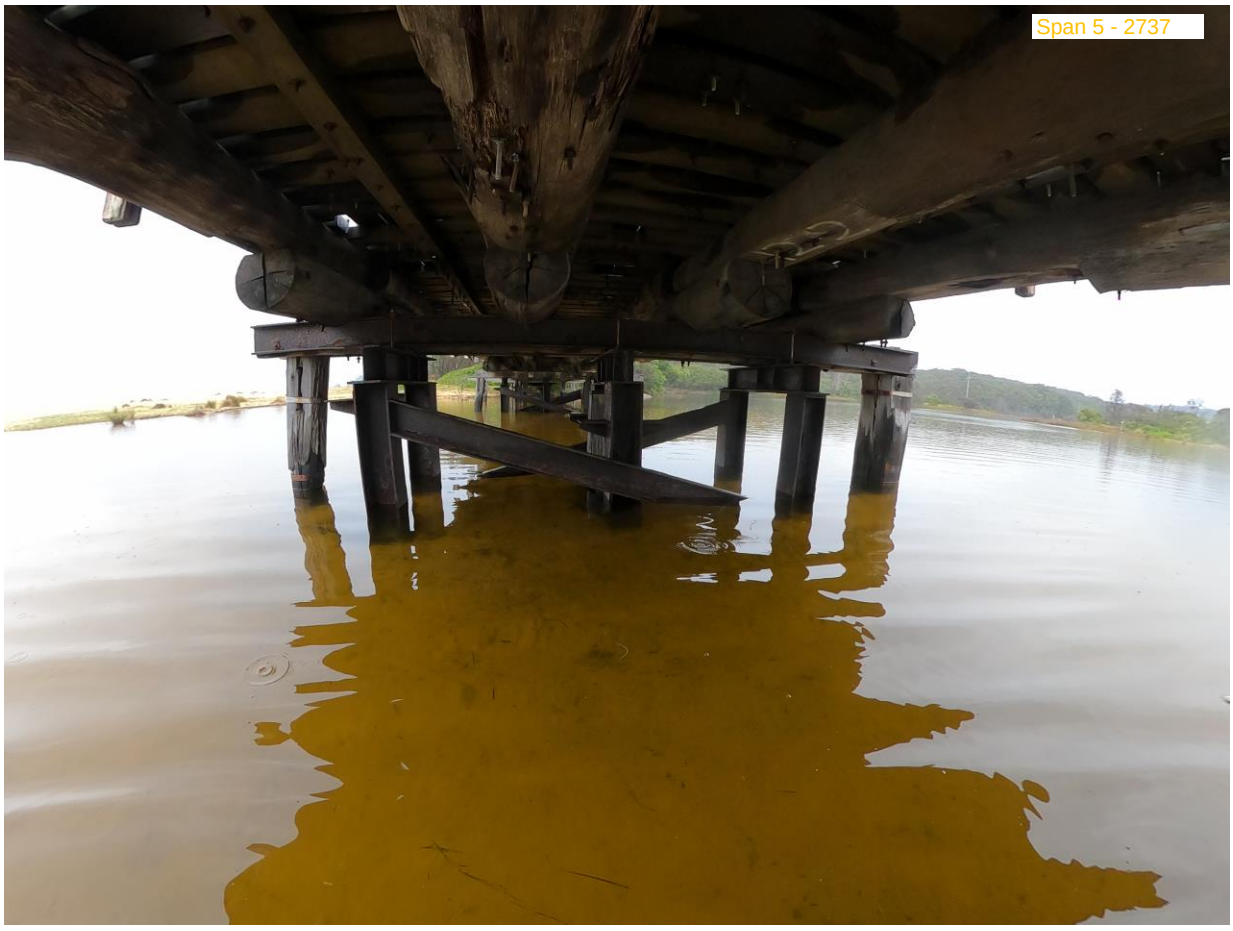

Span 6 - 2727

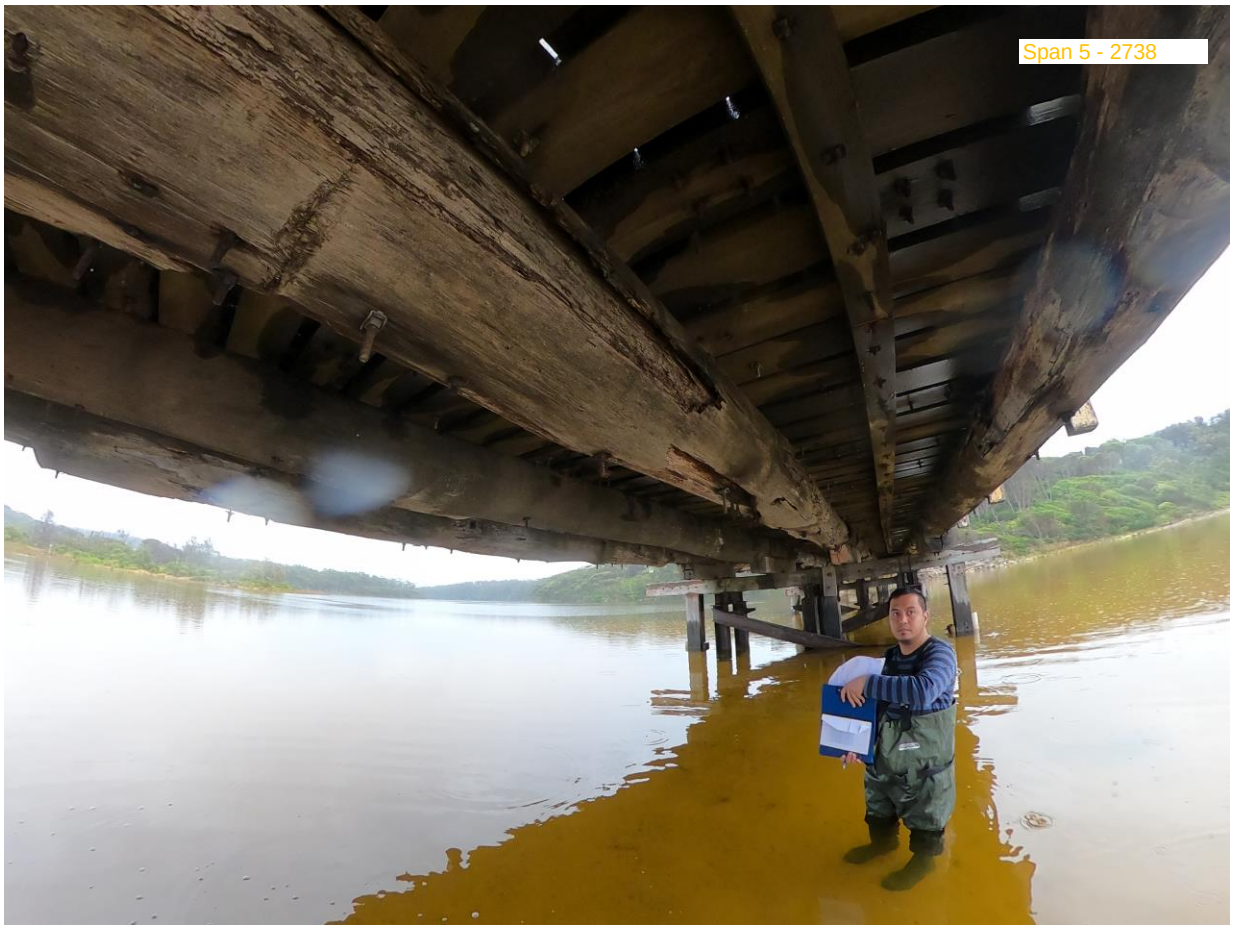

Pier 5 - 2725


Pier 5 - 2732


Pier 5 - 2733


Span 5 - 2736

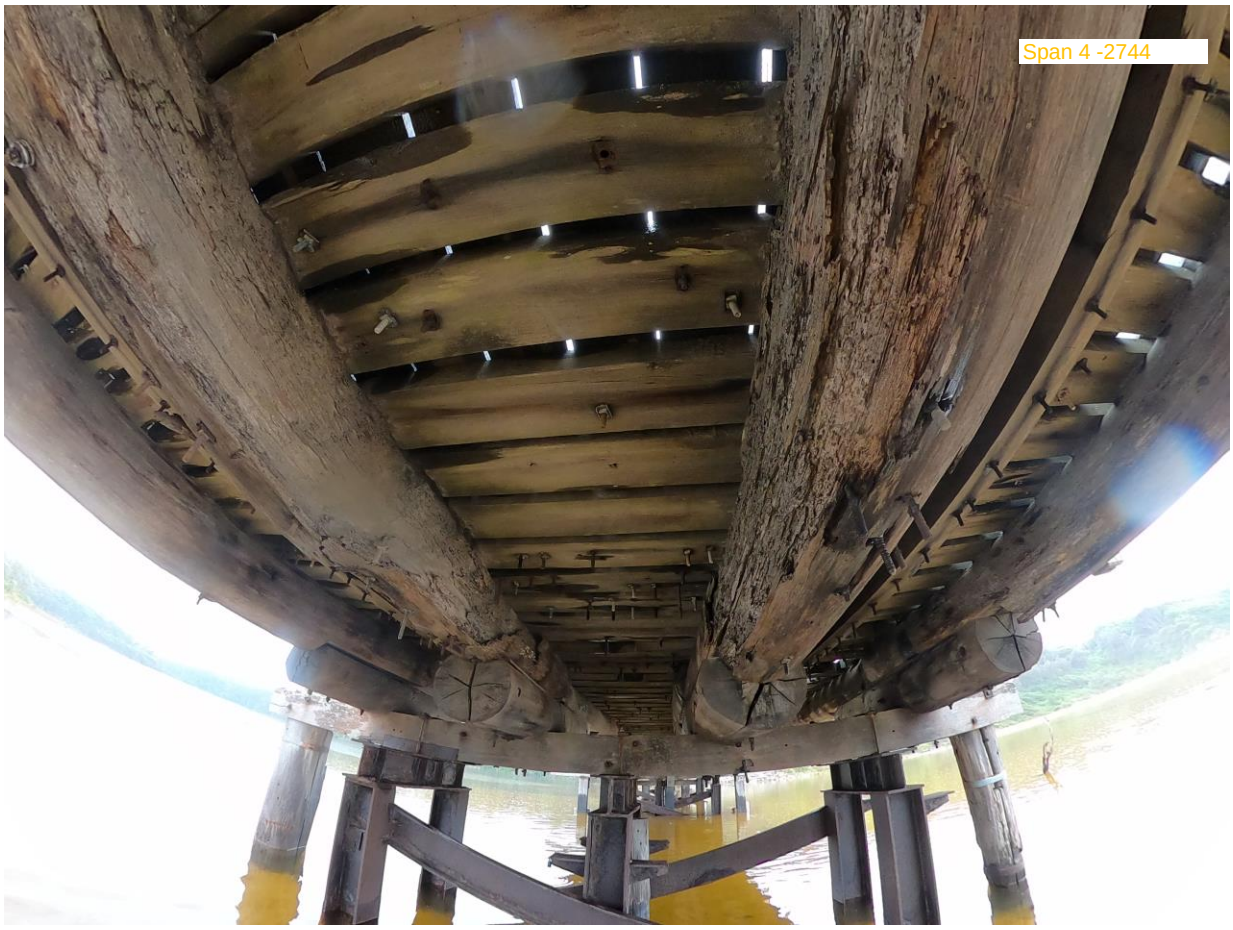

Span 5 - 2737


Span 5 - 2738


Pier 4 - 2739


Pier 4 - 2737


Pier 4 - 2743


Span 4 -2744


Span 4 -2745

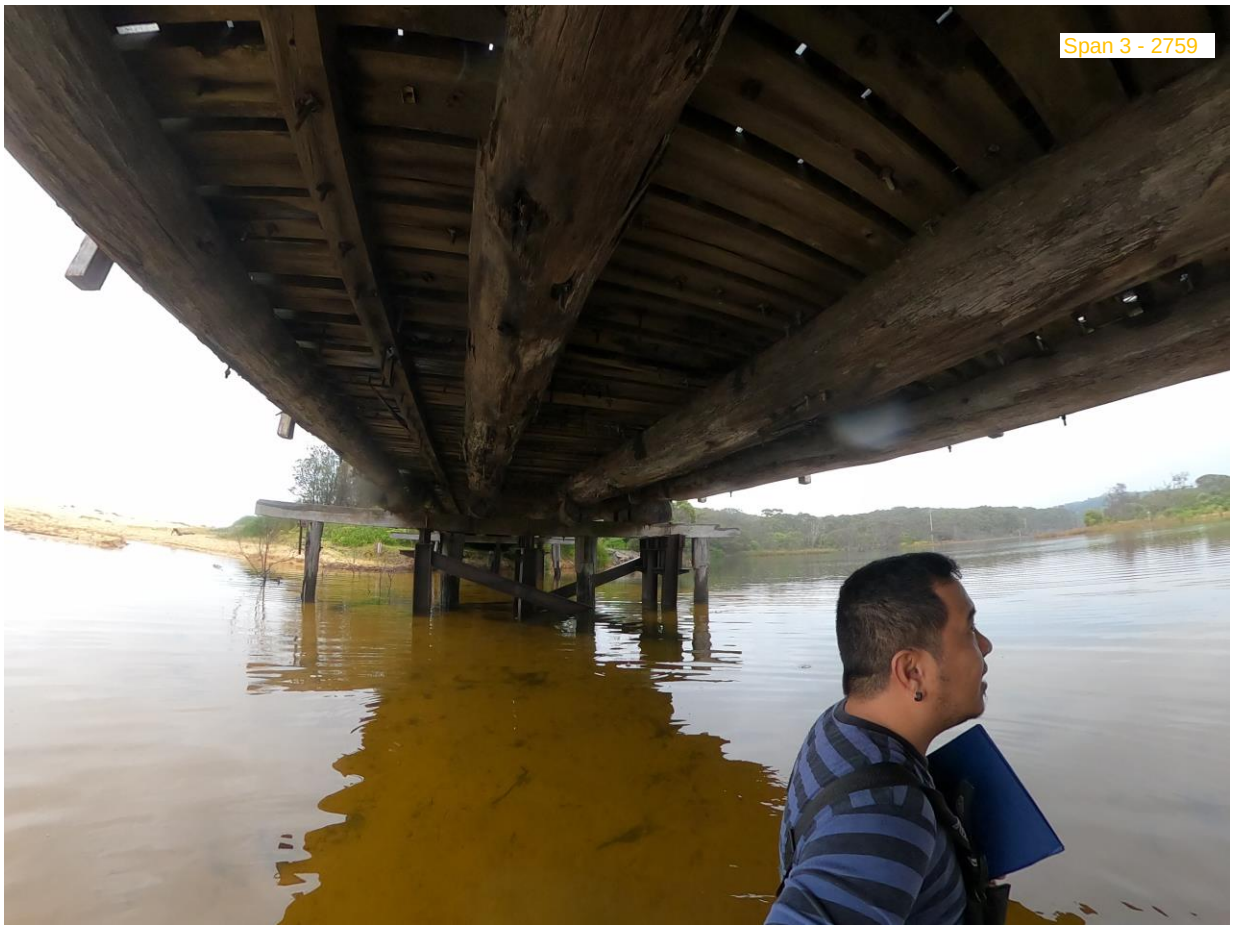

Span 4 -2747

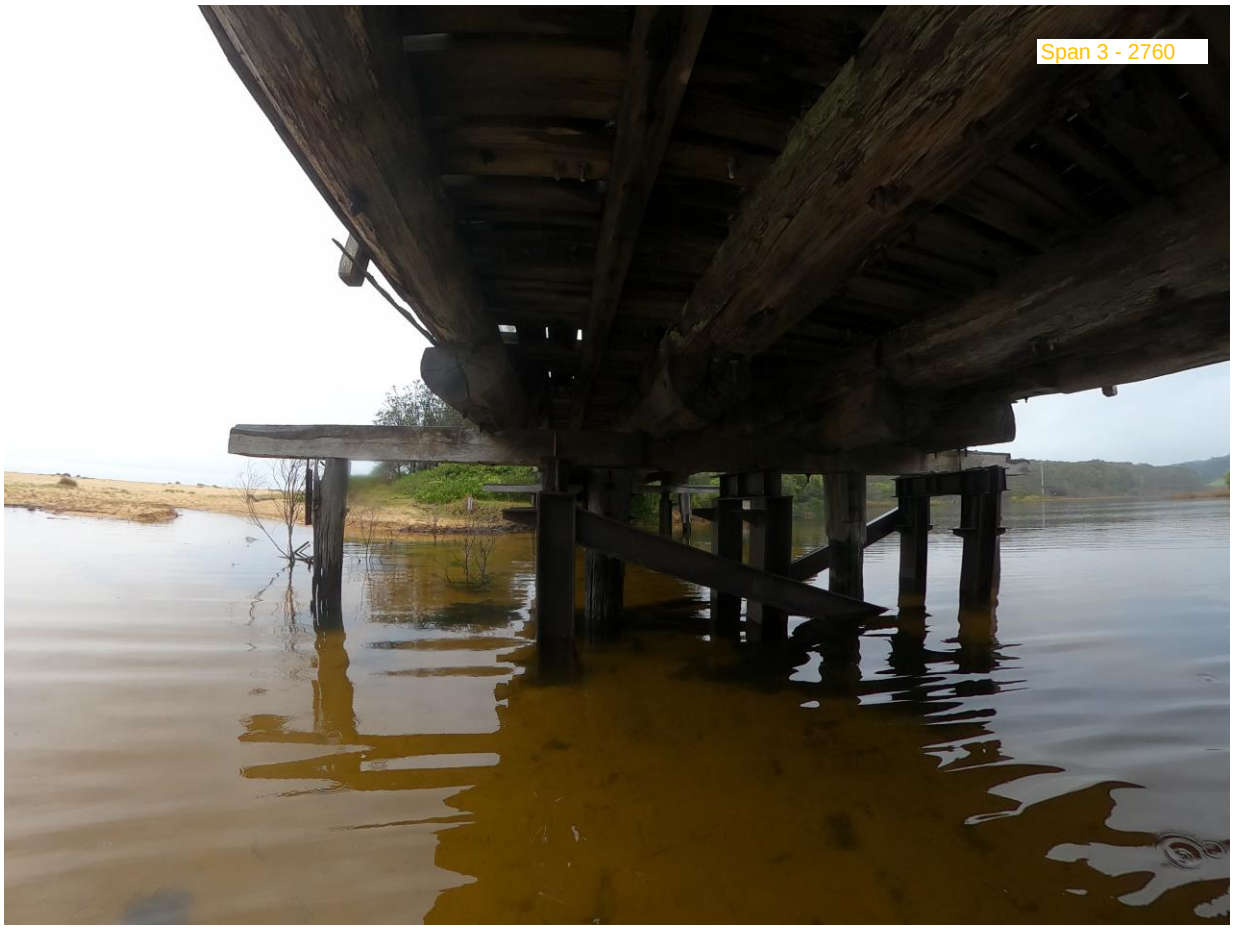

Span 4 -2752


Pier 3 -2746


Pier 3 -2755


Span 3 - 2756


Span 3 - 2759


Span 3 - 2760


Span 3 - 2761


Span 3 - 2762


Pier 2 - 2763


Pier 2 - 2764


Pier 2 - 2766

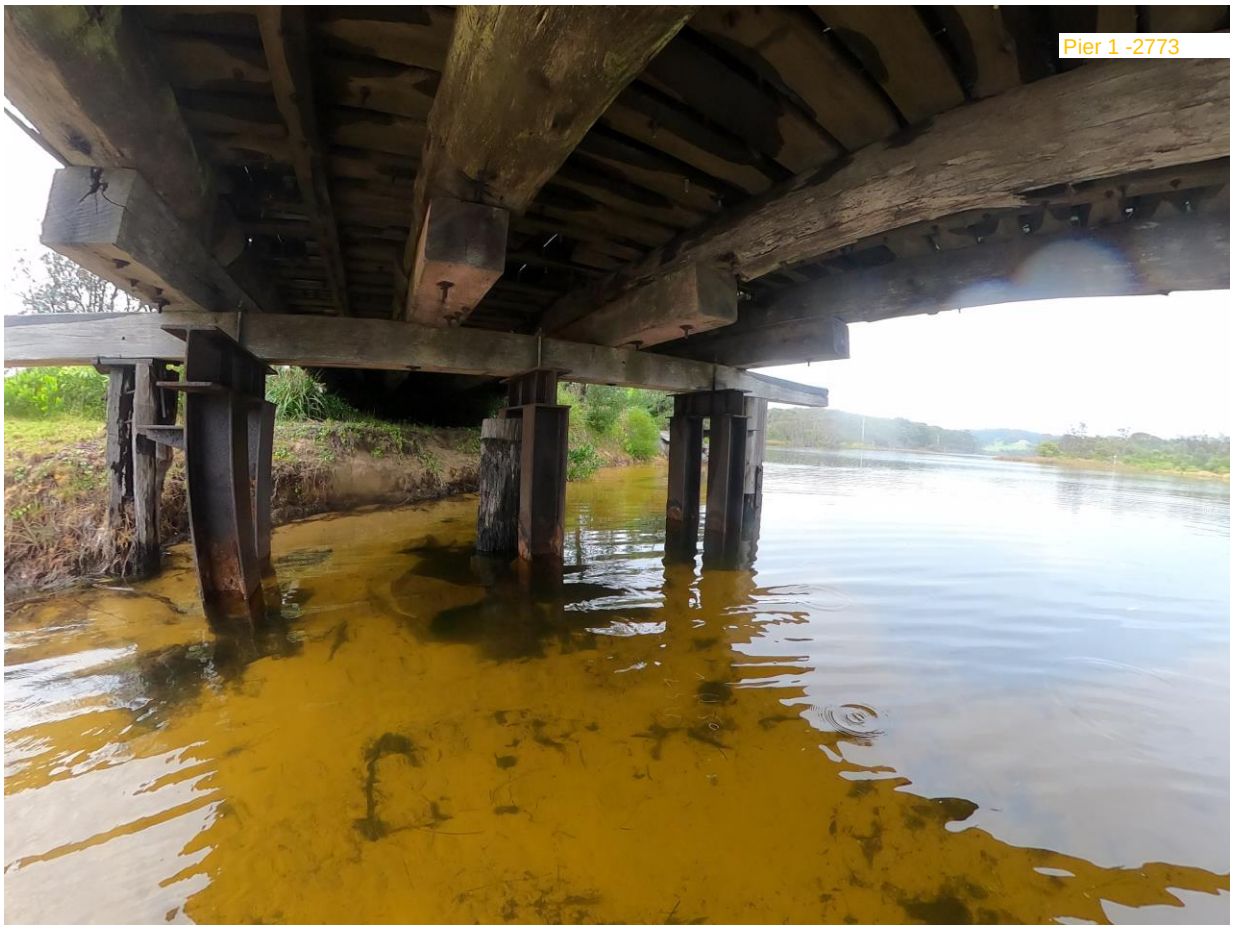

Pier 2 - 2767

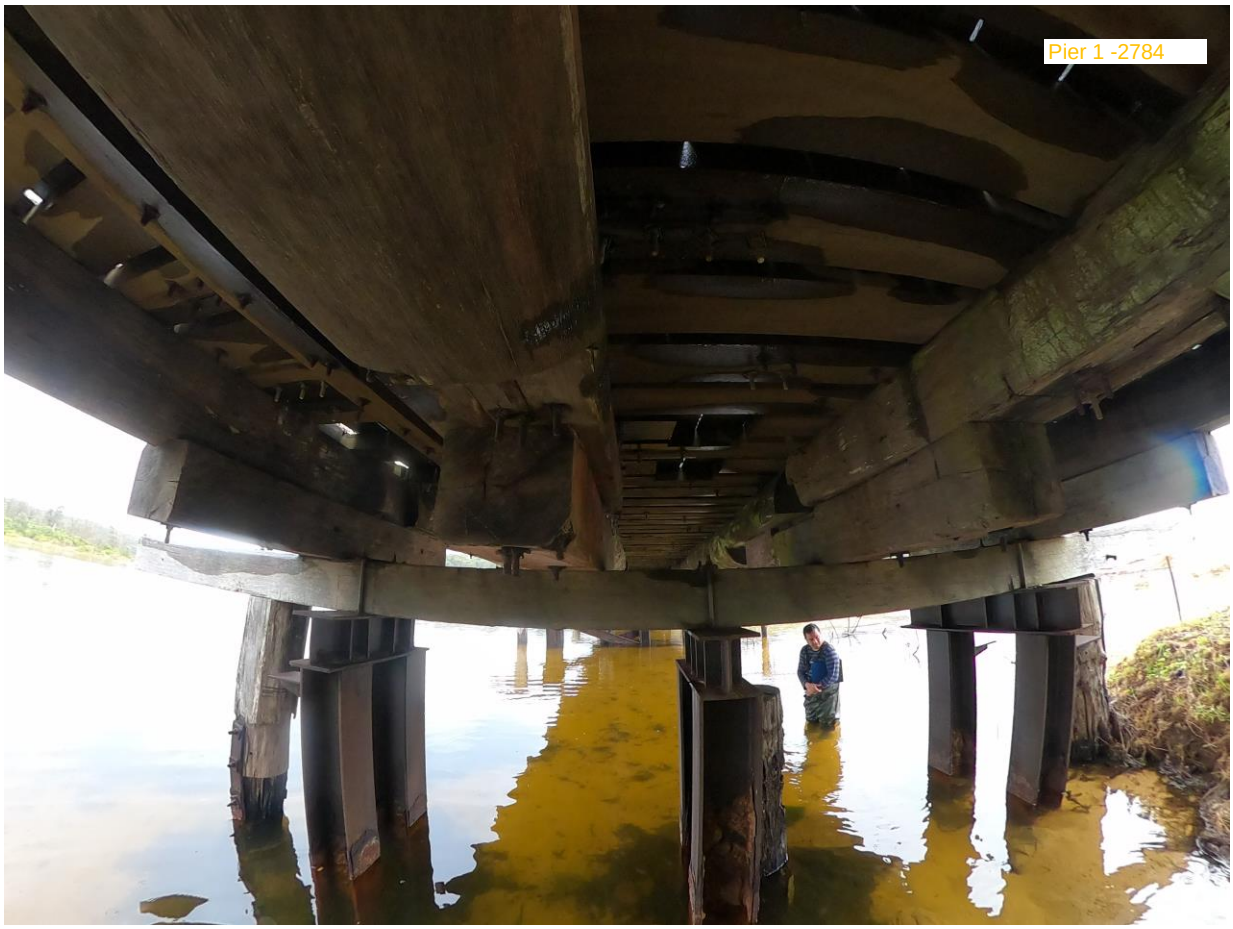

Span 2 -2768


Span 2 -2769


Span 2 -2770


Span 2 -2771

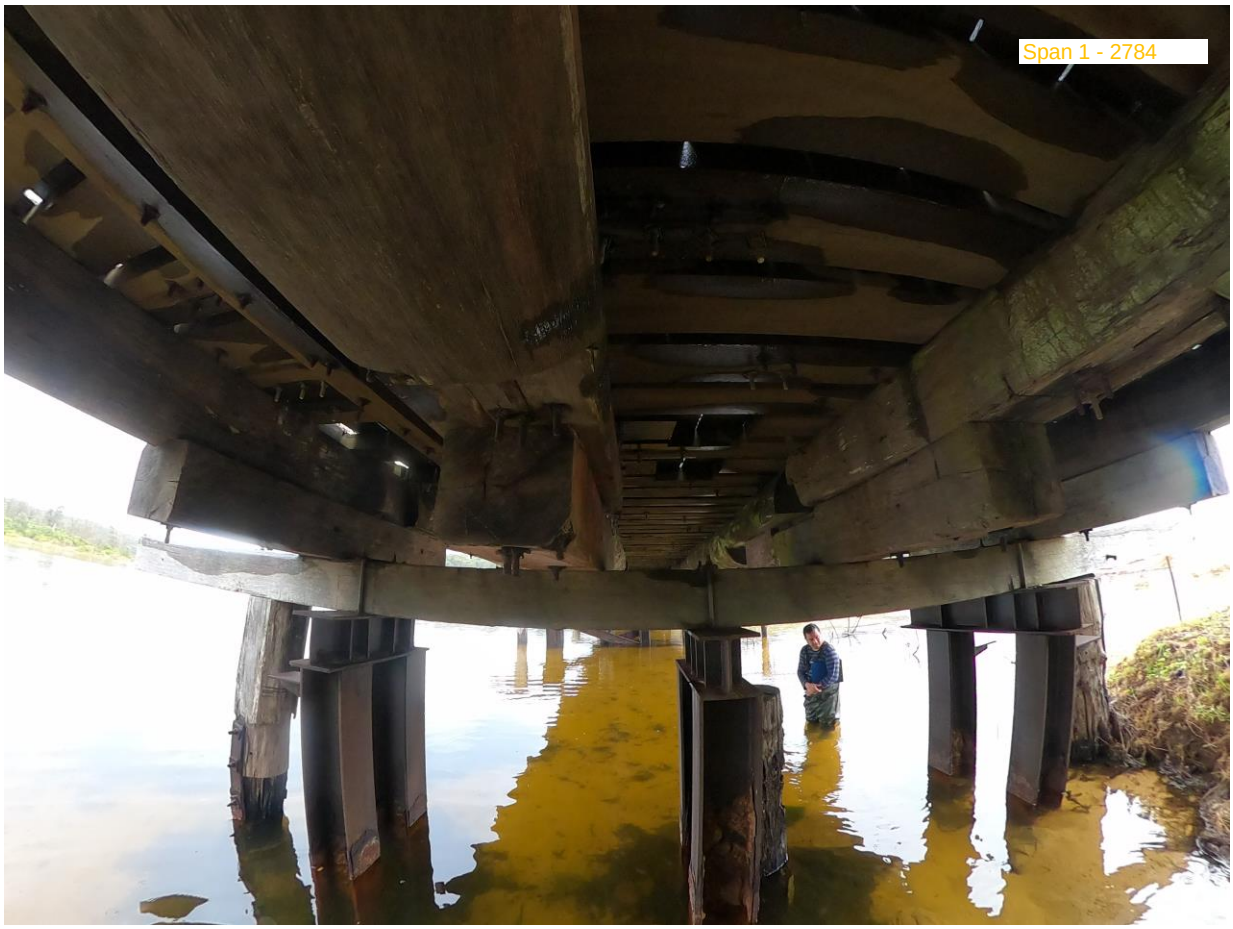

Pier 1 -2773

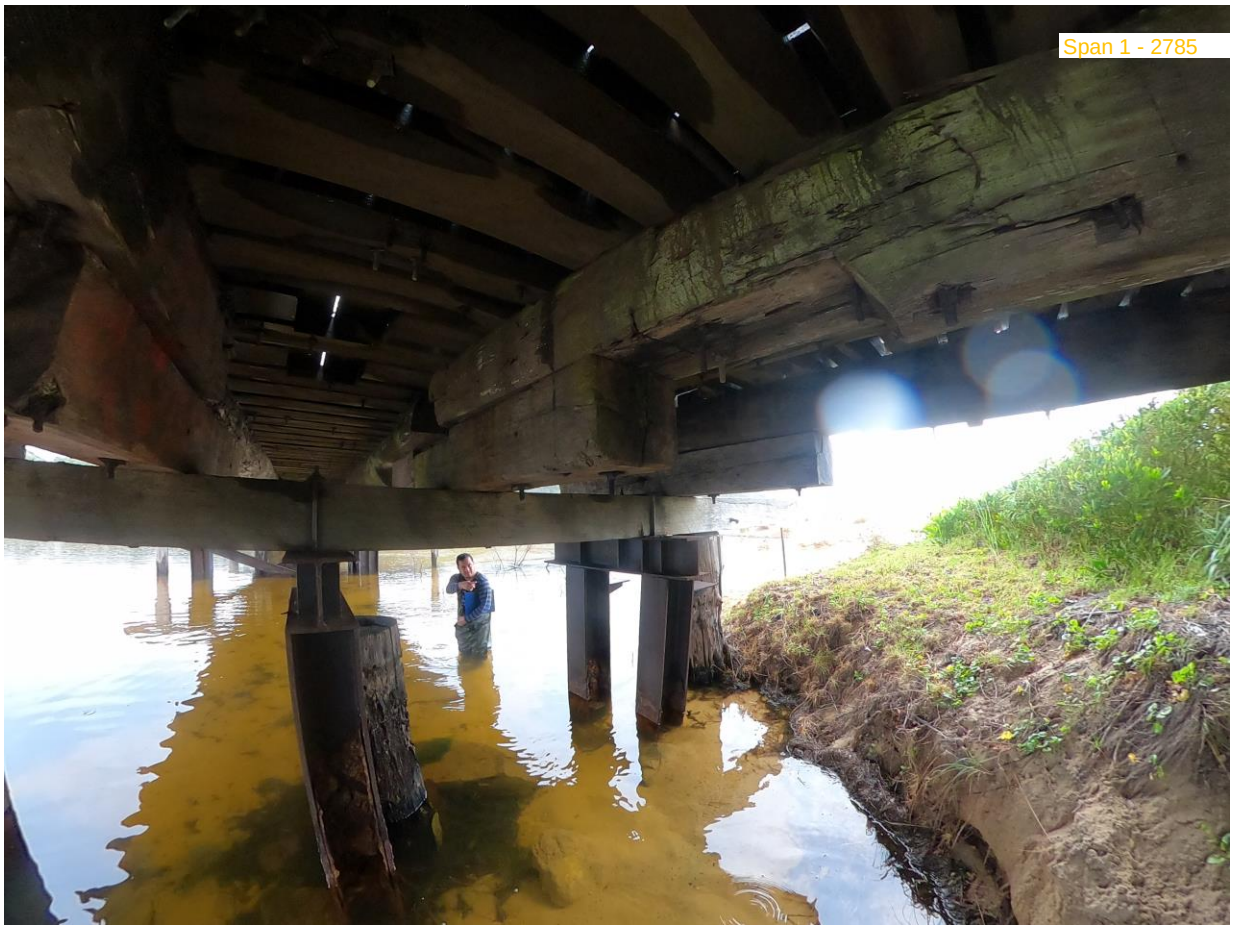

Pier 1 -2784


Span 1 - 2778

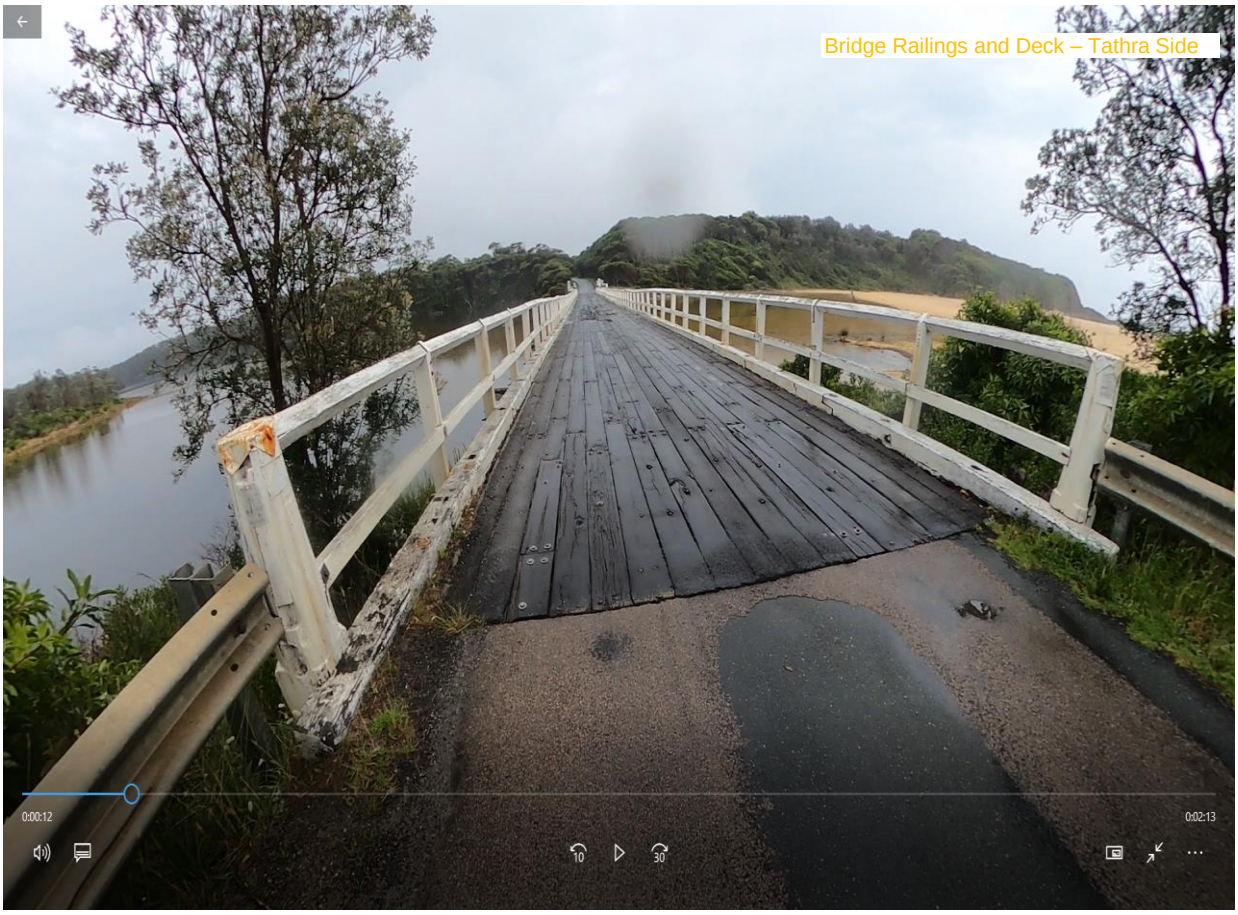

Span 1 - 2779

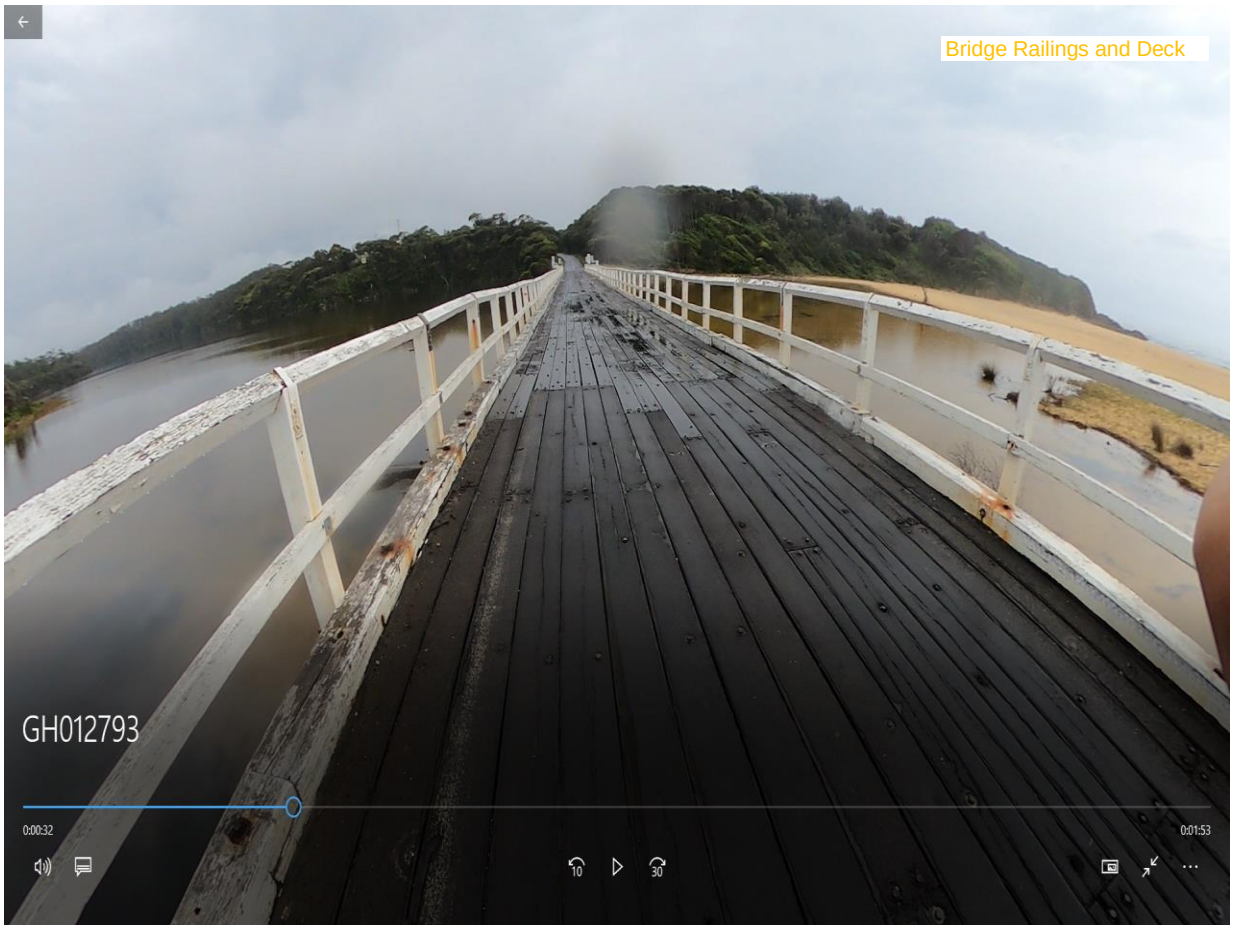

Span 1 - 2781


Span 1 - 2784

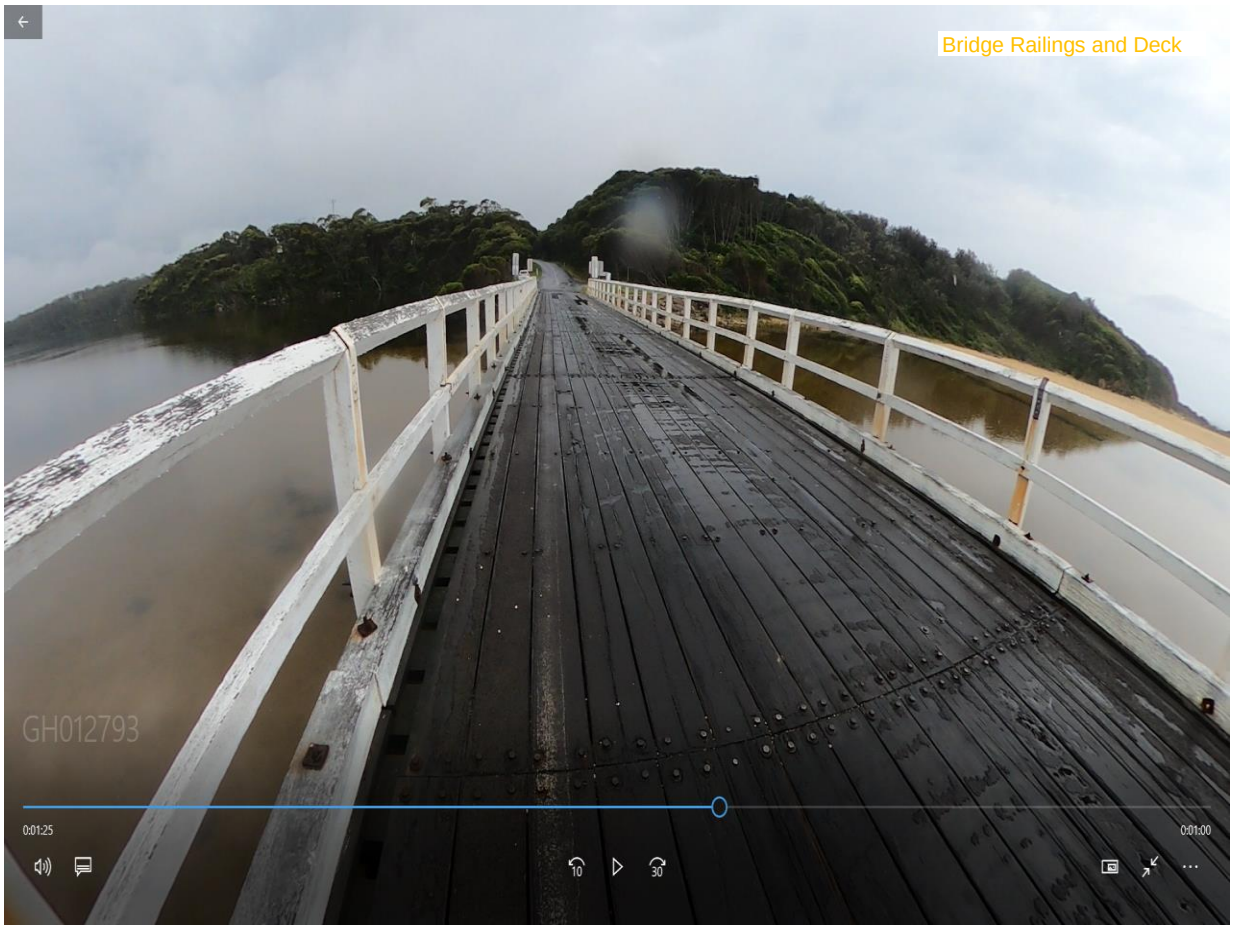

Span 1 - 2785

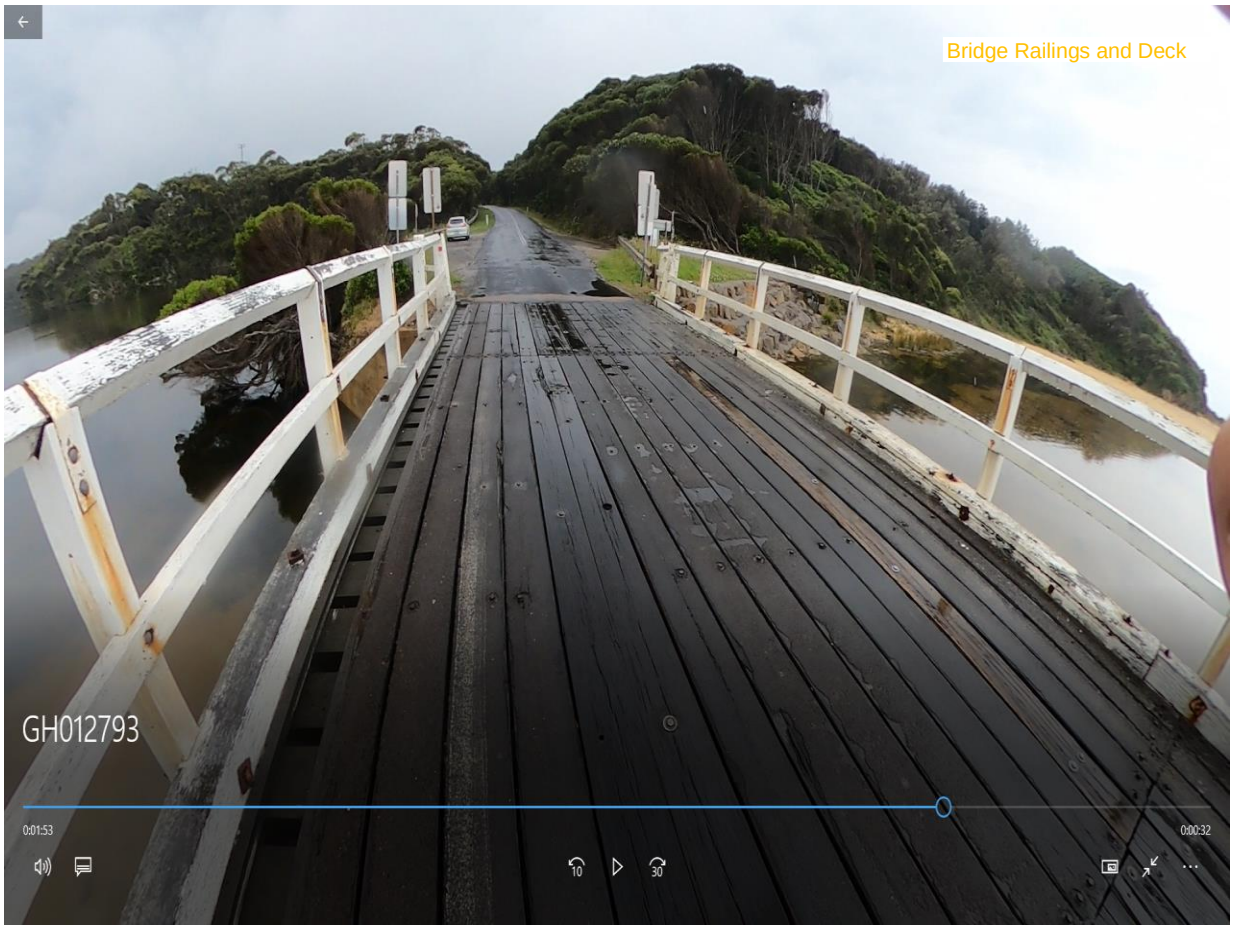

Bridge View East Side


Bridge Railings and Deck – Tathra Side
0:00:12
0:02:13


Bridge Railings and Deck
GH012793
0:00:32
0:01:53


Bridge Railings and Deck
GH012793
0:00:38
0:01:47


Bridge Railings and Deck
GH012793
0:01:25
0:01:00


Bridge Railings and Deck
GH012793
0:01:53
0:00:32


Bridge View – Bermagui Side
BRIDGE
LOAD
LIMIT
22.5t
GROSS
HEAVY
VEHICLES
NOT TO
EXCEED
10 km/h
WHEN
CROSSING
BRIDGE
GH012793
0:02:21
0:00:04